Trapping and Coded Wire Tagging of Wild Juvenile Chinook Salmon in the Upper Fraser River, 1979-1981.

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ABSTRACT

Fedorenko, A.Y.,A.L.Kahl and P.E.I.Fee . 1983. Trapping and coded wire tagging of wild juvenile chinook salmon in the upper Fraser River, 1979 to 1981. Can. MS Rep. Fish. Aquat. Sci. 1733: 46p.

During 1979, 1980 and 1981, juvenile chinook salmon (*Oncorhynchus tshawytscha*) were captured in the upper Fraser River system at Tete Jaune and coded wire nose tagged. Chinook fry were pen-reared, mostly in Moose Lake, prior to tagging in 1979 and 1980, and were tagged when captured in 1981.

Peak fry emergence and downstream distribution occurred approximately in mid-May and peak yearling migration occurred in April and early May. Size of emergent fry averaged 36 mm and 0.4 g in early May; size of migrating yearlings averaged 77 mm and 5.0 g at that time.

The annual numbers of chinook tagged and released (corrected for tag loss and post-tagging mortality) were as follows: in 1979, 77,688 mainstem fry (code 02-19-22) and 547 mainstem yearlings (code 02-21-27); in 1980, 30,680 mainstem fry captured by inclined plane trap (code 02-18-13), 10,107 mainstem fry captured by beach seine (code 02-20-63), 14,148 Swift Creek fry (code 02-18-11), and 320 mainstem and Swift Creek yearlings (code 02-18-61); and in 1981, 23,685 mainstem fry (code 02-19-38). Mean size of tagged fry each year was 57 mm and 2.2 g in 1979; 45 mm to 54 mm and 0.8 g to 2.0 g in 1980; and 54 mm and 1.5 g in 1981. Mean size of tagged yearlings was 83 mm and 5.8 g in 1979; and 75 mm 4.2 g (mainstem) and 80 mm, 5.8 g (Swift Creek) in 1980.

Overall mean tag retention averaged 98% for fry and 99% for yearlings. Pre-and post-tagging mortalities were each less than 1% of total taggable fry and less than 2% of total taggable yearlings. Water temperatures at tagging sites ranged from 3.5°C to 6.5°C during tagging of yearlings, and from 8.0°C to 16.5°C during tagging of fry.

Key Words: Chinook salmon, Fraser River, Coded Wire Tagging, CWT.

Résumé

Fedorenko, A.Y., A.L.Kahl and P.E.I.Fee. 1983. **Trapping and coded wire tagging of wild juvenile chinook salmon in the upper Fraser River, 1979 to 1981.** Can. MS Rep. Fish Aquat. Aquat. Sci. 1733: 46p.

En 1979, 1980 et 1981, de jeunes saumons quinnats (**Oncorhynchus tshawytscha**) ont été capturés à Tête-Jaune dans le bassin supérieur du fleuve Fraser et on leur a fixé une étiquette nasale métallique codée. En 1979 et 1980, des alevins de saumon quinnats ont été élevés en enclos, la plupart dans le lac Moose, avant d'être étiquetés, et en 1981, ils ont été étiquetés lors de leur capture.

La période culminante de sortie des alevins et de leur distribution en aval s'est située à la mi-mai et celle de la migration des poissons d'un an, en avril et au dèbut de mai. Les alevins à leur sortie au début de mai mesuraient en moyenne 36 mm et pesaient 0, 4g; à ce moment-là, les saumons d'un an en migration avaient en moyenne une longueurde 77 mm et un poids de 5, 0g.

Le nombre total par année de saumons quinnats étiquetés et libérés (chiffres corrigés pour tenir compt des étiquettes perdues et de la mortalité survenue aprés l'étiquetage) est le suivant: en 1979, 77,688 alevins de bras principal (code 02-19-22) et 547 saumons d'un an du bras principal (code 02-21-27); en 1980, 30,680 alevins du bras principal capturés à l'aide d'une trappe à plan incliné (code 02-08-13), 10,107 alevins de bras principal capturés au moyen d'une senne de rivage (code 02-20-63), 14,148 alevins de ruisseau Swift (code 02-18-11) ainsi 320 saumons d'un an du bras principal et du ruisseau Swift (code 02-18-61); et en 1981, 23,685 alevins du bras principal (code 02-19-38). La taille et le poids moyens des alevins étiquetés étaient respectivement pour 1979, de 57 mm et de 2, 2g; pour 1980, de 45 à 54 mm et de 0, 8 à 2, 0; et pour 1981, de 54 et de 1, 5g. Quant aux saumons d'un an étiquetés, la taille et le poids moyens étaient respectivement en 1979 de 83 mm et de 5, 8g, et en 1980, de 75 mm et 4, 2g pour le bras principal et de 80 mm et 5, 8g pour le ruisseau Swift.

Dans l'ensemble, 98% des alevins en moyenns et 99% des saumons d'un an ont gardé leur étiquette. La mortalité tant avant qu'après l'étiquetage a été inférieure à 1 % du nombre total des alevins étiquetables et à 2 % de celui des saumons d'un an. Aux endroits d'étiquetage, la température de l'eau a varié de 3, 5 à 6, 5°C lors de l'étiquetage des saumons d'un an, et de 8, 0 à 16, 5°C lors de l'étiquetage des alevins.

Mots-clés: saumons quinnat, fleuve Fraser, étiquettes métalliques codées, EMC

INTRODUCTION

The upper Fraser River and it's tributaries above Prince George (Fig.1) support approximately 11% of the total Fraser River chinook spawning escapement (7,275 fish, 1971 - 1980 mean, Table 1). One of the most important spawning areas in this region occurs in the mainstem Fraser River in the area of Tête Jaune Cache (Fig.2). During the 1950's, approximately 5,000 chinook spawned in the Tête Jaune area, but recently the number of reported spawners declined to only a few thousand (2,580 fish, 1978 - 1982 mean) (Table 1).

During 1979, 1980 and 1981 wild juvenile chinook in the Tête Jaune area were coded wire tagged (CWT). The program was one of many CWT programs initiated in the Fraser River watershed to document chinook exploitation patterns, survival rates and temporal aspects of migration prior to implementation of the Salmonid Enhancement Program.

The CWT method implants a small (< 1 mm) binary coded stainless steel tag in the nose cartilage of juvenile fish. Tagged fish are identified by removal of the adipose fin and subsequently recovered in commercial and sports fishery sampling programs and on the spawning ground. Data generated from these studies will be used to formulate a management and enhancement plan for Fraser River chinook.

This report summarizes the capture, handling and tagging techniques used, as well as the migratory timing, size and growth of fry in the Tête Jaune area. Subsequent tag recovery data will be summarized in future reports.

DESCRIPTION OF STUDY AREA

The study area, located in the headwaters of the Fraser River, consisted of Moose Lake the mainstem spawning area at Tête Jaune Cache, and Swift Creek (Figs.1 & 2).

The Fraser River originates on the western slopes of the Rocky Mountains and flows northwest for approximately 70 km to Moose Lake. From Moose Lake (approximately 12 km long) the Fraser River flows west for approximately 18 km to Overlander Falls, a 9 m fall that totally obstructs salmon passage. From Overlander Falls, the Fraser River continues in a westerly direction for approximately 17km to Rearguard Falls, a 15 m stepfall that partially obstructs salmon passage.

Between Overlander and Rearguard Falls, Swiftcurrent Creek enters the Fraser River from the north. This creek is glacial fed and imparts a glacial colour to the Fraser River mainstem making observations of adult fish difficult except during freezing weather when glacial input is minimal.

Five kilometers below Rearguard Falls and just west of Tête Jaune Cache, the Fraser

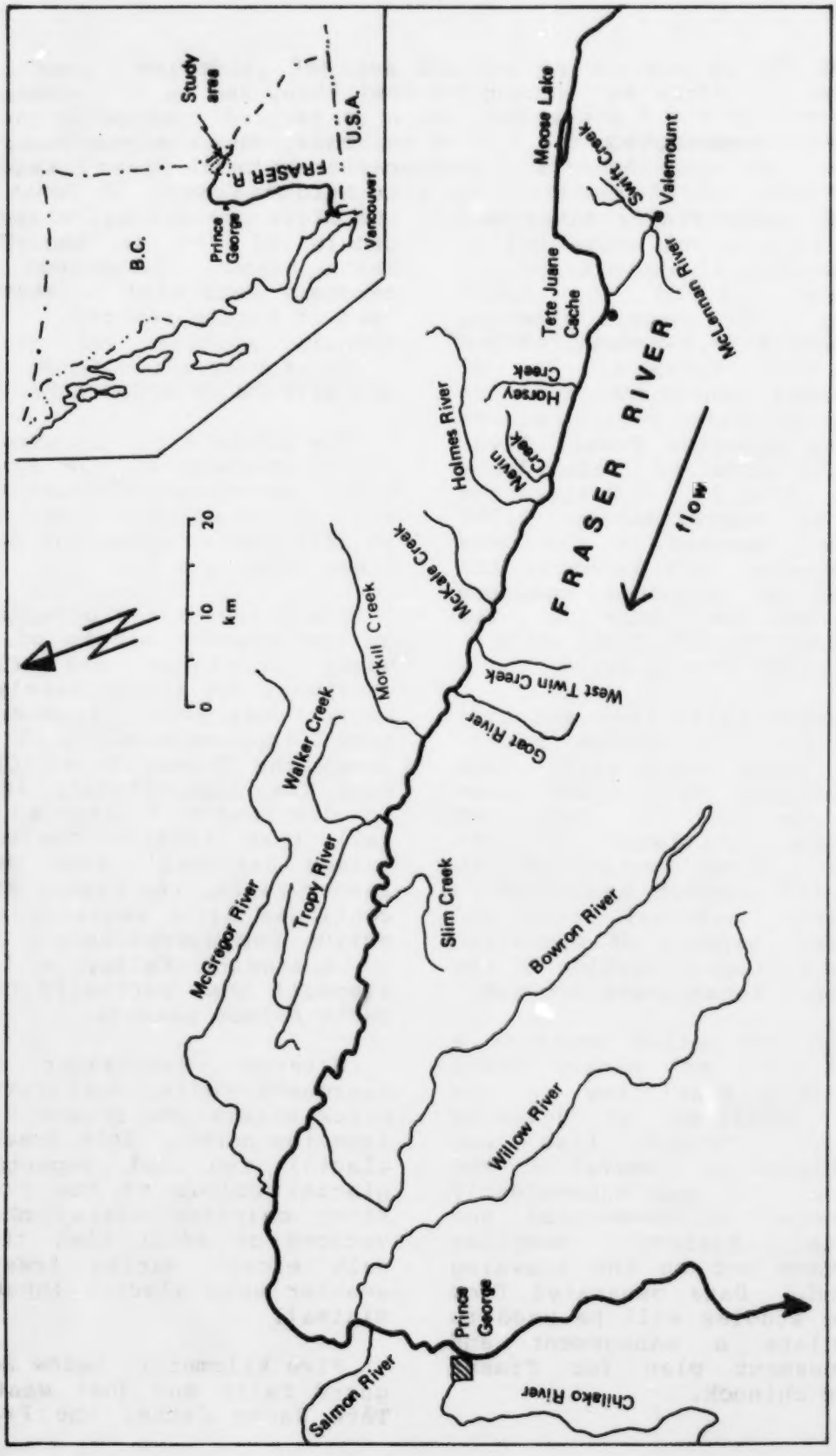

Fig. 1. Fraser River above Prince George.

TABLE 1.ANNUAL CHINOOK ESCAPEMENT TO UPPER FRASER RIVER AND TRIBUTARIES ABOVE PRINCE GEORGE,1951-1982

YEAR	BOWRON RIVER	FRASER MAIN STEM	GOAT R	HOLMES RIVER	MCGREGOR R	MORKILL	NEVIN CR	SALMON RIVER	SLIM CR	SWIFT CR	TORPY RIVER	WALKER CR	WILLOW RIVER	MISC. TRIBS.	TOTAL
1951	PRES	7500	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	PRES	N/R	7500
1952	500	7000	N/R	N/R	N/R	N/R	N/R	PRES	N/R	N/R	N/R	N/R	PRES	N/R	7500
1953	750	9000	N/R	N/R	N/R	N/R	N/R	PRES	N/R	N/R	N/R	N/R	PRES	N/R	9750
1954	750	6500	N/R	N/R	1500	N/R	N/R	PRES	N/R	N/R	N/R	N/R	200	N/R	8950
1955	400	4500	N/R	N/R	1250	N/R	N/R	PRES	N/R	N/R	N/R	N/R	200	N/R	6350
1956	400	4500	N/R	N/R	750	N/R	N/R	PRES	N/R	N/R	N/R	N/R	75	N/R	5725
1957	750	5500	N/R	N/R	750	N/R	N/R	PRES	N/R	N/R	N/R	N/R	PRES	N/R	7000
1958	1500	5500	N/R	N/R	900	N/R	N/R	500	N/R	N/R	N/R	N/R	250	N/R	8650
1959	400	1500	N/R	N/R	400	N/R	N/R	N/R	N/R	N/R	N/R	N/R	PRES	N/R	2300
1960	400	475	N/R	N/R	125	N/R	N/R	25	N/R	N/R	N/R	N/R	25	N/R	1050
1961	750	140	20	40	325	170	N/R	10	500	N/R	250	N/R	20	N/R	2225
1962	1500	600	N/R	400	750	400	200	25	1500	N/R	1500	N/R	75	200	6950
1963	400	1000	N/R	300	850	400	100	50	500	N/R	600	N/R	100	100	4300
1964	750	1500	N/R	N/R	1100	N/R	N/R	200	1750	N/R	600	N/R	75	N/R	5975
1965	750	400	N/R	N/R	700	N/R	N/R	200	500	N/R	200	N/R	25	N/R	2775
1966	750	600	N/R	400	500	N/R	N/R	125	700	N/R	350	N/R	40	N/R	3465
1967	400	750	25	400	700	N/R	N/R	150	650	N/R	650	N/R	100	N/R	3825
1968	400	1350	25	400	200	N/R	N/R	75	750	N/R	400	N/R	75	N/R	3675
1969	400	1300	25	25	200	N/R	N/R	750	750	N/R	400	N/R	75	N/R	3925
1970	3500	1800	25	75	400	N/R	N/R	200	750	75	750	N/R	75	N/R	7650
1971	1200	1200	25	275	750	N/R	25	200	750	75	550	200	75	50	5325
1972	1300	1800	50	250	400	150	50	200	750	200	400	200	75	25	5825
1973	1000	1000	50	100	750	275	25	400	750	75	750	200	75	10	5450
1974	1000	1200	55	800	400	200	20	750	750	175	400	200	200	110	6150
1975	1200	1200	11	200	400	200	11	200	750	75	200	200	75	11	4722
1976	800	1800	25	75	760	200	25	200	1422	150	400	200	75	25	6132
1977	950	2000	20	150	1150	225	5	200	1900	275	400	125	115	15	7515
1978	2000	3500	70	675	730	200	30	400	1600	200	200	150	200	60	9955
1979	1350	1800	15	450	1500	200	20	750	1500	350	750	200	750	60	9635
1980	2000	4000	85	500	1000	N/R	12	500	1900	350	550	250	500	24	11647
1981	1260	1800	20	400	702	150	5	175	1335	300	510	140	440	40	7237
1982	1400	1800	50	900	1485	N/R	40	300	1800	570	300	175	450	75	9270
AVE:															
51-60	650	5198	N/R	N/R	811	N/R	N/R	263	N/R	N/R	N/R	N/R	150	N/R	6478
61-70	960	944	24	255	573	323	150	179	835	75	570	N/R	66	150	4477
71-80	1280	1950	41	348	784	206	22	380	1207	193	460	193	214	39	7236
78-82	1602	2580	48	585	1083	183	21	425	1627	354	462	183	468	52	9549

MISC. TRIBS.INCLUDE HORSEY,MCKALE AND WEST TWIN CREEKS
PRES - PRESENT
N/R - NONE RECORDED (SURVEY NOT CARRIED OUT)
N/O - NONE OBSERVED

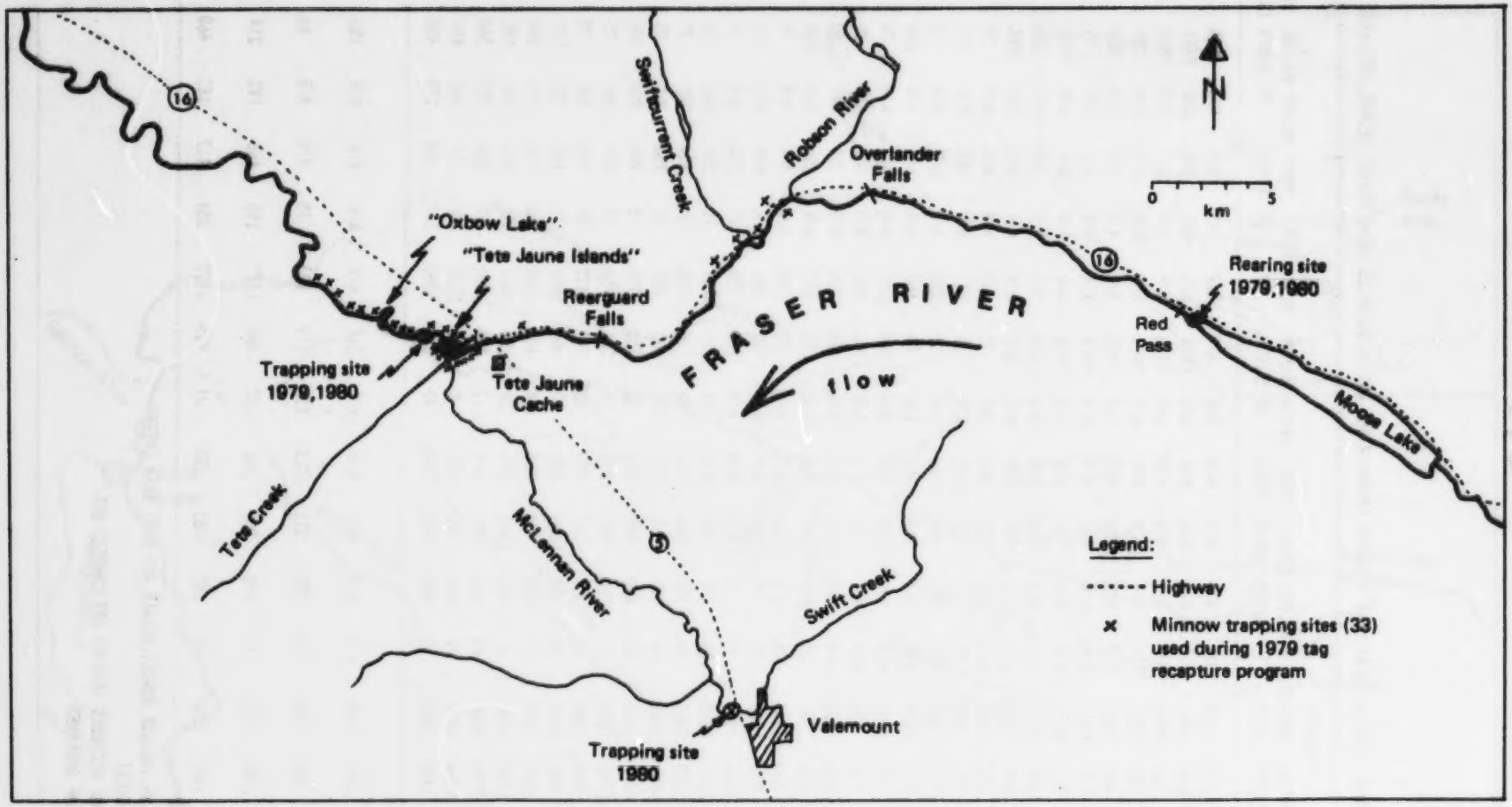

Fig. 2. Upper Fraser River study area showing locations of chinook capture and rearing sites.

River opens into a 2 km long braided section known as the "Tête Jaune Islands"(Fig.2). This area is the major spawning location in the study area. From this mainstem spawning area, the Fraser River continues for approximately 1,100 km, swinging first northwest then southward to the sea (Fig.1).

Annual mean flow (1956-1979 data) measured at Red Pass (Fig.2) is 46.9 m^3/sec, with flow extremes ranging from 3.5 m^3/sec to 402 m^3/sec (Dept. Env.1980). Monthly mean flows range from 6.1 m^3/sec (Feb.) to 157 m^3/sec (June). (Dept. Env. 1980).

Swift Creek, a tributary of the McLennan River (Fig.2), flows southwest for approximately 16 km and joins the McLennan River about 31 km upstream from its confluence with the Fraser River. Swift Creek is a braided and meandering clear water tributary with annual mean flow (1971-1979 data) of 3.3 m^3/sec (Dept. Env. 1980). Monthly mean flows range from 0.35 m^3/sec (March) to 12.0 m^3/sec (June) (Dept. Env. 1980). A water diversion dam located on Swift Creek at Valemount, approximately 4 km upstream from the confluence with McLennan River, totally obstructs salmon passage.

Monthly mean air temperatures at Valemount (Fig.1) range from 15.8°C in July to -11.0°C in January, with daily extremes of 40.6°C recorded in July and-51.1°C recorded in December (1951-1980 data; Env. Canada 1982). Monthly mean precipitation at Valemount ranges from 25.5 mm in March to 58.1 mm in January, with 36% of the mean annual precipitation recorded as snow fall (1951-1980 data, Env. Canada 1982).

SALMONID RESOURCE

Chinook are the only salmon species that spawn in the uppermost Fraser River watershed and the mainstem spawning areas in the study area are the only known spawning areas on the Fraser River mainstem. Mainstem spawning occurs primarily in the "Islands" area (1978-1982 mean 2580) with a smaller population (approx. 40-250 fish) spawning approximately 17 km upstream above Rearguard Falls at the mouth of Swiftcurrent Creek (Table 1).

Chinook arrive in the Tête Jaune area in early August and start to spawn in mid-August. Peak spawning occurs in early September and is generally complete by mid-September.

Chinook spawning in Swift Creek occurs approximately 3 weeks earlier than in the mainstem. Chinook spawn from 0.8 km above the creek mouth to the C.N.R. bridge in Valemount, a distance of approximately 3 km (Fig.2). Annual chinook escapement to Swift Creek during 1978 to 1982 averaged 354 fish (range of 200-570) (Table 1).

METHODS

FISH CAPTURE

Inclined plane traps (IPT) (Conlin and Tutty 1979) were the primary method used to capture chinook fry in the Fraser River mainstem during 1979 and 1980 and in Swift Creek during 1980. Beach seines were used on the mainstem to capture juveniles in 1979 and 1980, and were the primary method of fry capture in the mainstem in 1981. Minnow traps were used briefly in Swift Creek in 1980, and were used extensively in side channels on the Fraser River mainstem in 1981. Fish capture dates by area and method are presented in Table 2.

Inclined plane traps

Inclined plane trapping was conducted on the Fraser River mainstem and in Swift Creek. The mainstem site was situated approximately 1.7 km below the "Islands" spawning area (Fig.2) and consisted of a single 50 m wide channel. The Swift Creek site was located 0.8 km downstream from the #5 highway bridge (Fig.2) and consisted of a single 6 m wide channel. Some chinook spawning occurred downstream of the Swift Creek trap site; however the chosen site was the only accessable one with a single channel along the generally meandering and braided creek.

In 1979, one 4x4 (1.2 m x 1.2 m x 7.9 m) and two 2x3 (0.6 m x 0.9 x 2.4 m) incline plane traps were used on the mainstem from April 26 to June 5. In 1980, two 4x4, and two 2x3 traps were used from April 24 to June 15 on the mainstem, and three 2x3 traps were used from April 25 to June 11 on Swift Creek. The traps on the mainstem were attached to a 1.9 cm diameter cable strung approximately 50 m between old bridge pilings and trees on either side of the river. Traps on Swift Creek were anchored in a similar manner.

Traps were initially fished for 24 hours; however, preliminary catches indicated that primary downstream migration occurred at night and consequently a nightly fishing period was set from 2100 to 0800 hours. Traps were generally cleaned of debris once each night (at 2400 hrs) and more frequently during periods of high debris accummulation.

Captured fish were removed from the trap boxes each morning using fine mesh nylon dipnets, placed in 17.5 l plastic pails and moved to shore for sorting and enumeration. Chinook fry were either counted individually or estimated volumetrically, depending on the size of catch; fish other than chinook fry were noted for presence and released.

After sorting and enumeration, chinook fry were transferred to one of four marquisette net bags suspended in a 151 l tank and transported by truck to Moose Lake for rearing. At Moose Lake, the marquisette bags containing fish were placed in 23 litre pails

and carried to the rearing site where the fish were released into pens. Due to low water temperatures (around 3.8°C) and consequently high dissolved oxygen levels in the water, aeration during transport was not provided. Approximately 7,500 fish were transported during each trip in 1979 and approximately 2,700 fish in 1980.

Beach Seines

Beach seines (1.8 m x 15 m) constructed of 1.2 cm mesh with a 0.6 cm mesh bunt were used to capture rearing chinook fry. In 1979 and 1980, seining was conducted opportunistically in a 5.3 km reach from the top of the "Islands" spawning area to the "Oxbow Lake" area (Fig.2). Seining was conducted from May 22 to June 15 in 1979 and from April 30 to June 18 in 1980. In 1981, seining was conducted from June 8 to June 27, as far as 13 km downstream of the "Islands" spawning area but primarily in the "Oxbow Lake" area (Fig.3).

Captured fish were separated by species and chinook fry were enumerated at the capture site either individually or volumetrically depending on the size of catch. All chinook larger than 50 mm were enumerated individually. In 1979, all captured chinook were transported as above, to the rearing pens in Moose Lake. In 1980, chinook captured in the mainstem area were also transported to rearing pens in Moose Lake. However, between June 4 and 18, 1980, fry captured in the "Oxbow Lake"area were held at the site in net-pens and those fish sufficiently large for tagging were tagged and released on site. Fry that were too small for tagging(< 45 mm) were transported to Moose Lake on June 23.

In 1981, rearing fry captured by beach seine were enumerated and held on site in net-pens before tagging.

Minnow traps

"Gee" minnow traps baited with chum roe were used to capture chinook fry in Swift Creek between June 11 and June 13, 1980, and in the mainstem (primarily the "Oxbow Lake" area) between June 10 and June 27, 1981. During 1980, captured fry were enumerated and transported as above to Moose Lake for rearing. In 1981, captured fry were enumerated and held on site in net-pens before tagging.

FISH REARING

In 1979 and 1980, captured chinook fry were reared in enclosures at the outlet of Moose Lake (Fig.2) until they were large enough for coded wire tagging (> 45 mm). In addition, chinook fry caught during June 1980 in the "Oxbow Lake" area were held in netpens on the site and fed Oregon Moist Pellets (OMP) until tagging on June 20. After June 20 fry that were too small to tag were transported to Moose Lake for further rearing.

Table 1. Trapping dates and effort by year and method for Tête Jaune mainstem and Swift Creek, 1979 - 1981.

Capture site and year	CAPTURE METHOD: Inclined plane traps — Type	Period of operation	No. days	Beach seines — Period of operation	No. days	No. sets	Minnow traps — Period of operation	No. days	No. traps/day
TÊTE JAUNE MAINSTEM									
1979	4x4	Apr.27-June 5	38	May 22-June 15	15	N.A.[a]	_____	Not done	_____
	2x3,#1	Apr.26-May 25	30						
	2x3,#2	Apr.27-June 5	35						
1980	4x4,#1	Apr.24-June 15	51	Apr.30-June 18	29	459	_____	Not done	_____
	4x4,#2	Apr.24-June 15	51						
	2x3,#1	Apr.26-May 23	21						
	2x3,#2	Apr.26-May 24	8						
1981	_____	Not done	_____	June 8-27	17	187	June 10-27	15	34-120
SWIFT CREEK									
1980	2x3,#1	Apr.25-June 11	48	_____ Not done _____			June 11 - 13	3	
	2x3,#2	May 11-June 11	32						
	2x3,#3	May 11-May 20	9						

a Not available.

Fig. 3. Beach seining in the Oxbow Lake area, 1981.

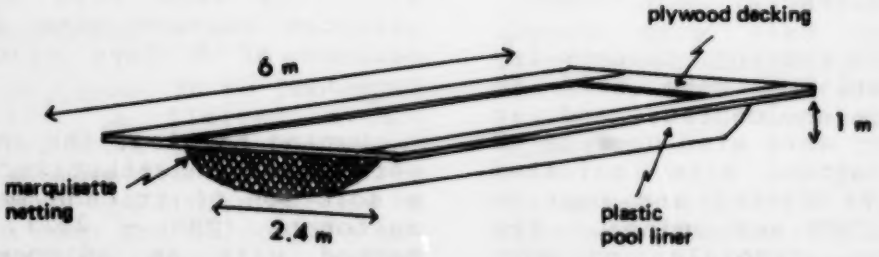

Fig. 4. Floating raceway used for rearing in 1979 and 1980 (diagrammatic).

The rearing enclosures in Moose Lake consisted of floating marquisette net-pens (0.9 m x 0.9 m x 2.1 m deep) strung on ABS pipe frames(Conlin and Tutty 1979) and a floating raceway (6.1 m x 2.4 m x 1.0 m deep) (Fig.4). Floatation for the net-pens was provided by boat bumpers. The raceway was semi-circular in cross section with side walls constructed of heavy gauge plastic (pool liner) and end walls of marquisette netting (Fig.4). Floatation for the raceway was provided by a log frame and four 170 l plastic barrels in 1979 and styrofoam blocks in 1980. Plywood decking was constructed around the raceway in both years to provide easy access for feeding and cleaning. All enclosures were covered with netting or screening to provide protection from predators and to prevent escape of fish.

Fry were fed OMP ranging in size from 0.8 mm initially to 1.2 mm at the end of rearing. Fry were sampled weekly (n=50 to 300) in order to determine food requirements according to the OMP Feeding Chart (R.V. Moore Co. Inc.).

During rearing, chinook fry and yearlings were held in separate enclosures, and in 1980, fry were also segregated as to capture site (mainstem and Swift Creek) and capture method (IPT and seine). Fry additions, removals and mortalities were recorded daily. Pens and the raceway were checked regularly for tears and brushed to remove algae and debris.

Fry were checked for disease symptoms throughout the rearing period and all dead fish were removed and examined for specific symptoms and disease. No disease problems were evident in 1979. However, in July 1980, during a period of chronic fry mortality, bacterial gill disease was diagnosed by the Diagnostic Service of the Fish Health Program at Nanaimo Biological Station. Consequently, fry were treated with teramycin in the daily food ration between July 14 and July 28.

FISH TAGGING AND RELEASE

In 1979 and 1980, fry tagging was conducted at the Moose Lake rearing site from July 26 to 30 in 1979 and from July 27 to 31 in 1980; chinook yearlings were tagged in May of each year. In addition, fry caught by beach seine in the "Oxbow Lake" area between June 4 and 18, 1980, were tagged and released at that site on June 20.

In 1981, fry were tagged and released in the "Oxbow Lake" area between June 14 and 27. Fry were held at the mainstem capture site for a maximum of 6 days prior to tagging.

During tagging, the chinook were first anaesthetized with a solution of tricane methane sulfonate (TMS - 222), then marked with an adipose fin clip and tagged with binary coded wire nose tags. Different tag codes were used for each age group (0+ and 1+) and capture site (mainstem and Swift Creek), and in 1980,

fish caught by inclined plane trap and beach seine were also tagged with different codes. Yearlings from the mainstem and Swift Creek were tagged using the same code in 1980. Fry less than 45 mm were released untagged.

Prior to release, all chinook yearlings and representitive samples of chinook fry were held for 24 to 48 hours (300 - 600 fry/sample in 1979; 70 - 300 fry/sample in 1980; and 170 - 300 fry/sample in 1981) to test for tag retention and post-tagging mortality.

Fraser River mainstem fish tagged at Moose Lake in 1979 and 1980 were transported and released in the mainstem at the top of the "Islands" area; Swift Creek fish tagged at Moose Lake in 1980 were transported and released in that creek. Up to 8,000 chinook at a time were transported and all fish were released at dusk. Aeration during transport was provided using a 12 volt recreational vehicle pump in 1979 and a cylinder of compressed oxygen in 1980.

TAG RECAPTURE

From August 26 to September 5, 1979, a limited minnow trapping program was conducted on the mainstem in order to determine the distribution of tagged fish and to compare the size of pen-reared and naturally rearing fish. Generally, five minnow traps were set for one to 27 hours (avg. 16 hrs) at each of 33 trapping sites located from the confluence of Robson and Fraser rivers to 9 km below the Tête Jaune spawning grounds (Fig.2). Traps were baited with chum roe. All captured chinook juveniles were checked for the presence or absence of adipose fin.

In 1980 and 1981, recaptures of juvenile chinook with missing adipose fins were monitored and, prior to release, the marked fish were passed through the Quality Control Device to check for tag presence.

BIOLOGICAL SAMPLING

In 1979 and 1980, chinook fry were randomly subsampled weekly from each rearing enclosure for nose-fork length (± 1 mm, n= 25 to 100) and weight (± 0.1 g, n= 50 to 300). In 1981, captured chinook juveniles were also sampled at least weekly for nose-fork length, weight and scale smears (n= 25) were taken for age determination.

In all years, chinook yearlings were subsampled randomly for length (n= 25) and aggregate weight (n= 30 to 50) as above, and in 1980, scale smears were also collected from larger juveniles from the mainstem (n= 25) and Swift Creek (n= 35) for age determination.

During the 1979 fall tag recovery program, all captured chinook juveniles were sampled for length, as above, and 25 fish were also sampled for scale smears.

PHYSICAL SAMPLING

In 1979 and 1980, surface water temperatures were recorded daily in the mainstem and in 1980 at the Swift Creek trapping sites and in both years at the Moose Lake rearing site (Fig.2). In 1981, surface water temperatures were recorded daily in the mainstem (1979 and 1980 trapping site) and in the "Oxbow Lake" area (Fig.2). All measurements were taken with 7 and 31 day Taylor continuous recording thermographs. Water temperatures were also monitored during transport and tagging of fish.

Water flows for the upper Fraser River (Red Pass manual gauge station No. 08KA007 at outlet of Moose Lake) were provided by the Water Survey of Canada, Inland Waters Directorate.

RESULTS

FISH CAPTURE

Chinook juveniles

The estimated catch of chinook fry and yearlings by capture site and method is presented in Table 3 and Appendices 1 to 4.

During 1979, 1980 and 1981, an estimated 88,559, 55,467 and 29,470 chinook fry, as well as 666, 281 and 0 chinook yearlings were captured in each consecutive year in the Fraser River mainstem. In addition, during 1980, an estimated 17,086 chinook fry and 63 chinook yearlings were captured in Swift Creek. The above mainstem catch totals in 1979, 1980 and 1981 include trap and seine mortalities which accounted for 3.7% of the total mainstem three year catch (Appendices 1-3). Trap mortalities in Swift Creek in 1980 accounted for 3.6% of the total creek catch (Append.4). Chinook mortality was negligible during fish transport to Moose Lake rearing site in 1979 and 1980.

In 1979, 87% of the total chinook catch in the mainstem was captured by inclined plane traps and the remainder by beach seines. The available data showed that the mean daily catch per seine set ranged from 3.1 to 168.3 chinook (Append.1).

In 1980, 65% of the total chinook catch in the mainstem was captured by inclined plane traps and the remainder by beach seines. Nearly 100% of the chinook catch in Swift Creek was captured by inclined plane traps (catch with minnow traps in Swift Creek was negligible). Mean daily catch per seine set on the mainstem ranged from 0.5 to 124.1 chinook and averaged 43.0 chinook (Append.2). Catch effort on Swift Creek using minnow traps was negligible because fish were too small for efficient trapping. (Append.4).

In 1981, 65% of the total chinook catch in the mainstem was captured by beach seine and the remainder by minnow trap . Mean daily catch per seine set ranged from 9.4 to 340.3 chinook and averaged 130.8 chinook (Append.3).

Table 3. Estimated annual catch of 0+ and 1+ chinook juveniles at Tête Jaune mainstem and Swift Creek by capture method, 1979-1981 (numbers in parenthesis indicate % of total).

Capture site and method	No. days fished	0+ Chinook No. live	0+ Chinook No. dead	0+ Chinook Total	1+ Chinook No. Live	1+ Chinook No. dead	1+ Chinook Total
TETE JAUNE MAINSTEM							
1979							
4x4	38	53,120	1,288	54,408	597	17	614
2x3, #1	30	13,108	272	13,380	27	2	29
2x3, #2	15	8,864	221	9,085	8	0	8
Total traps	–	75,092	1,781	76,873 (86.8)	632	19	651 (97.7)
Beach seines	15	10,423	1,263	11,686 (13.2)	15	0	15 (2.3)
Overall total	—	85,515	3,044	88,559 (100)	647	19	666 (100)
1980							
4x4, #1	51	16,789	312	17,101	60	1	61
4x4, #2	51	16,717	399	17,116	209	5	214
2x3, #1	21	1,036	15	1,051	1	0	1
2x3, #2	8	438	2	440	5	0	5
Total traps	–	34,980	728	35,708 (64.4)	275	6	281 (100)
Beach seines	29	19,105	654	19,759 (35.6)	0	0	0 (0)
Overall total	—	54,085	1,382	55,467 (100)	275	6	281 (100)
1981							
Beach seines	17	19,851	161	19,012 (64.5)	0	0	0
Minnow traps	15	10,417	41	10,458 (35.5)	0	0	0
Overall total	—	29,268	202	29,470 (100)	0	0	0
SWIFT CREEK							
1980							
2x3, #1	48	10,723	380	11,103	62	1	63
2x3, #2	32	5,144	228	5,372	0	0	0
2x3, #3	9	584	5	589	0	0	0
Total traps	–	16,451	613	17,064 (99.9)	62	1	63 (100)
Minnow traps	3	22	0	22 (0.1)	0	0	0 (0)
Overall total	—	16,473	613	17,086 (100)	62	1	63 (100)

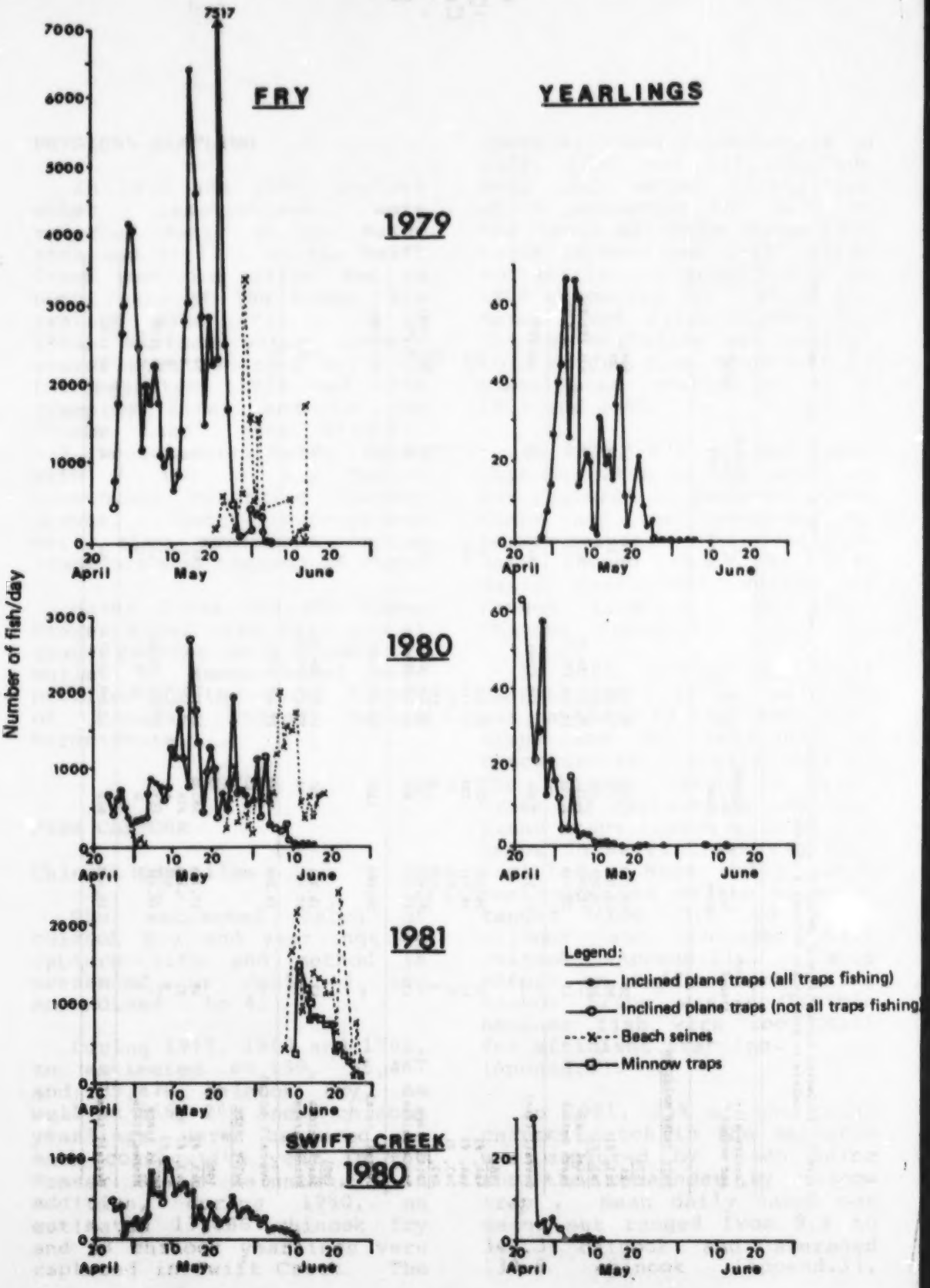

Fig. 5. Migration timing and occurrence of chinook fry and yearlings in upper Fraser River at Tete Jaune (1979-1981) and in Swift Creek (1980).

Mean daily catch per minnow trap ranged from 1.6 to 14.6 chinook and averaged 8.3 chinook (Append.3).

Other fish species

During the 1979 to 1981 tagging programs on the mainstem, dace, Dolly Varden, cutthroat trout, redside shiners, prickly sculpins, northern squawfish (juveniles), suckers (bridgelip and large scale) and mountain whitefish (juveniles and adults) were captured incidently to chinook juveniles.

Migration timing

Emergence and initial downstream distribution of fry in mainstem and Swift Creek occurred from the end of April to mid-June, as indicated by the 1979 and 1980 inclined plane trapping data (Fig.5). Series of migration peaks were observed in both years, but the major peak occurred around mid-May. Significant numbers of rearing chinook fry were present during June, as indicated by beach seining data (1979-1981) and minnow trapping data (1981) (Fig.5). Yearlings in the mainstem and Swift Creek appeared to migrate largely during April in 1980 and May in 1979. (Fig.5).

FISH REARING

The numbers of fish reared in Moose Lake in 1979 and 1980 are summarized in Table 4.

In 1979, an estimated 85,515 chinook fry were reared in Moose Lake during April 26 to July 30. However, the actual number of penned fry, as indicated by the rearing mortality records and tagging inventory (No. tagged + No. undersized + No. pre-tagging mortalities) (Table 5) was 91,079 fish. Rearing mortality (6,352 fish) constituted 7.0% of the total penned fry; an additional 4,442 fry were lost from an overturned pen. Fry density per pen varied during rearing due to additional captures until June 15. The maximum number of fry at any one time was estimated at 9,300 fish in a pen and 39,000 fish in the raceway. Feed ration, expressed as percent of total fry weight per feeding, generally ranged from 3.4% at start to 4.6% at end of rearing.

During May 11 to 31, 1979, 568 chinook yearlings were reared in a separate pen in Moose Lake. Rearing mortality was 0.9% (5 fish). Feed ration averaged 1.9% of the total fish weight per feeding.

In 1980, an estimated 63,488 chinook fry were reared in Moose Lake during April 25 to July 31. An additional 7,070 were reared in the "Oxbow Lake" area from June 4 to 23. Of the fry reared in Moose Lake, 47,015 were trapped and beach seined in mainstem and 16,473 were trapped in Swift Creek. The actual number of penned fry, as indicated by the rearing mortality records and tagging inventory (No. tagged + No. undersized + No. pre-tagging mortalities) (Table 5) was 69,892. Rearing mortality

Table 4. Pen-rearing summary for chinook juveniles, 1979, 1980.

	Capture site	Capture method	Rearing site	Rearing interval	Rearing temperature	Rearing mortality[a]	No. fish lost	Estimated No. surviving penned fish	Estimated No. total penned fish[b]	Actual No. surviving penned fish[c]	Actual No. total penned fish[d]
1979											
Fry	Tête Jaune mainstem	I-PT[e] and beach seines	Moose L.	Apr.26-July 30	2.5-11.8°C	6,352	4,442[f]	74,721	85,515	80,285	91,079
Yearlings	Tête Jaune mainstem	I-PT	Moose L.	May 11-31	2.8-4.5°C	5	0	563	568	563	568
1980											
Fry	Tête Jaune mainstem	I-PT	Moose L.	Apr.25-July 31	3.5-13.5°C	5,843	0	29,137	34,980	34,260	40,103
	Tête Jaune mainstem	Beach seines	Moose L.	June 1-July 30	6.5-13.5°C	1,329	0	10,706[g]	12,035	4,054[g]	5,383
	Oxbow Lake area	Beach seines	Oxbow Lake area[i]	June 4-23	17.0-21°C[j]	70	0	7,000	7,070	6,802	6,872
	Swift Cr.	I-PT[h]	Moose L.	Apr.26-July 26	3.5-13.5°C	887	0	15,586	16,473	16,647	17,534
Total						8,129	0	62,429	70,558	61,763	69,892
Yearlings	Tête Jaune mainstem	I-PT	Moose L.	Apr.25-May 19	3.5-7.5°C	7	0	267	274	267	274
	Swift Cr.	I-PT	Moose L.	Apr.26-May 19	3.5-7.5°C	0	0	64	64	64	64
						7	0	331	338	331	338

a Includes diseased fish removed.

b Includes dead and lost fish.

c From tagging inventory (No. tagged + No. undersized released + No. pre-tagging dead + No. recaptures, Table 5).

d Includes rearing mortalities and lost fish.

e Inclined plane traps.

f Fry lost from overturned pen.

g Includes undersized Oxbow Lake fry (see footnote "i").

h Includes a few minnow trapped fish.

i After June 20 tagging, some 1730 undersized fry moved from Oxbow Lake pens to Moose Lake for further rearing.

j Only June 15 - 17 data available.

(8,129 fish) constituted 11.4% of the total penned fry. Increased fish mortality occurred in the rearing pens during June 20 to July 16,1980, and was attributed to myxobacterial and protozoan infections (diagnosed by G. Hoskins, Fish Health Program in Nanaimo). Fry density per pen varied during rearing due to additional captures until June 18 and fish redistributions among enclosures. The maximum number of fry at any one time was estimated at 12,800 fish in a pen and 39,300 fish in the raceway. Feed ration generally ranged from 3.6% at start to 6.2% at end of rearing.

During April 25 to May 19, 1980, 338 chinook yearlings (274 from the mainstem and 64 from Swift Creek) were reared in separate pens in Moose Lake. Rearing mortality was 2.1% (7 fish). Feed ration averaged 1.9% of the total fish weight per feeding.

In 1981, captured chinook fry were held only until tagging (maximum holding time was 6 days). Fewer than 3,900 fish were held in a pen and holding mortality was 2.2%.

FISH TAGGING

The numbers of fish tagged, fish sizes and mortality and tag retention rates are presented in Tables 5 and 6.

In 1979, 77,688 chinook fry and 547 chinook yearlings from the mainstem (corrected for tag loss and post-tagging mortality) were tagged and released with codes 02-19-22 and 02-21-27, repectively. Tagged fry averaged 56.5 mm and 2.2 g; yearlings averaged 82.5 mm and 5.8 g. Post-tagging mortality totalled 130 fry and 16 yearlings, and tag retention averaged 97.5% for fry and 98.8% for yearlings.

In 1980, 40,787 chinook fry from the mainstem and 14,148 chinook fry from Swift Creek (corrected for tag loss and post-tagging mortality) were tagged and released. Code 02-18-13 was used for 30,680 mainstem fry captured by inclined plane traps. Code 02-20-63 was used for 10,107 mainstem fry captured by beach seine, and code 02-18-11 was used for all the Swift Creek fry. In addition, 320 chinook yearlings (259 from the mainstem and 61 from Swift Creek) were tagged and released with code 02-18-61. Tagged fry ranged from 45.3 mm and 0.8 g for the "Oxbow Lake" fish to 54.1 mm and 1.8 g for the Swift Creek fish; yearlings averaged 74.6 mm and 4.2 g for the mainstem fish and 80.2 mm and 5.8 g for the Swift Creek fish. Post-tagging mortality totalled 248 fry and 1 yearling. Tag retention averaged 95.6% to 98.5% for the individually coded mainstem fry groups and 100% for yearlings.

In 1981, 23,685 chinook fry from the mainstem (corrected for tag loss and post-tagging mortality) were tagged and released with code 02-19-31; no yearlings were tagged in 1981. Tagged fry averaged 53.5 mm and 1.5 g; post-tagging mortality totaled 741 fry; and tag retention averaged 99.5%.

Table 5. Tagging summary for 0+ chinook juveniles from upper Fraser River, 1979 - 1981.

Year	Capture site	Capture method[a]	Mean size L	Mean size Wt.	Tagging period	Temperature range (°C)	Pre-tagging mortality	No. undersized fish released
1979	Tete Jaune mainstem	T & S	56.5 mm	2.16 g	July 26-30	8.0-11.8	131	168
1980	Tete Jaune mainstem	T	52.6 mm[b]	1.99 g[b]	July 30[c]31	10.0-12.5	42	2,382
		S	45.3 mm[b]	0.80 g[b]	June 20[b]	-		
			48.6 mm[c]	1.43 g[c]	July 31	10.0	29	1,829
1980	Swift Creek	T	54.1 mm	1.76 g	July 27,28,31	10.0-12.5	83	1,605
1981	Tete Jaune mainstem	S & M	53.5 mm	1.47 g	June 14-27	13.2-16.5	662	2,826

Year	Capture site	No. recaptures	Tagging code	Total No. tagged	Post-tagging mortality	Mean tag retention(and range)[d]	No. tags released[e]
1979	Tete Jaune mainstem	0	02-19-22	79,986	130	97.5%(92.6-99.6)	77,688
1980	Tete Jaune mainstem	0	02-18-13[f]	31,608[f]	28	98.4%(94.5-100)	30,680[f]
			02-20-63[g]	10,303[g]	94	98.5%(97.0-100)	10,107g.h.
1980	Swift Creek	0	02-18-11	14,959	126	95.6%(95.0-99.5)	14,148
1981	Tete Jaune mainstem	2,205	02-19-38	24,522	741	99.5%(98.0-100)	23,685

a T-inclined plane trap; S-beach seine; M-minnow trap.

b Fry from Oxbow Lake area.

c Fry from other mainstem area.

d Daily tag totals corrected with appropriate retention rates.

e Corrected for tag retention and post-tagging mortality.

f Trapped fry.

g Beach seined fry.

h Of these, 6,802 fry were beach seined in "Oxbow Lake" area (tagged June 30), and 3,305 fry were beach seined in other mainstem areas (tagged July 31).

Table 6. Tagging summary for 1+ chinook juveniles from upper Fraser River, 1979, 1980.

Year	Capture site	Mean size L	Mean size Wt.	Tagging period[a]	Temperature	Pre-tagging mortality	Recaptures
1979	Tête Jaune mainstem	82.5 mm	5.8g	May 31	3.5°C	5	0
1980	Tête Jaune mainstem	74.6mm[b]	4.2g[b]	May 20	6.5°C	4	4
1980	Swift Creek	80.2mm[b]	5.8g[b]	May 20	6.5°C	2	0

Year	Capture site	Tagging code	Total No. tagged	Post-tagging mortality	Tag retention	No. tags released[d]
1979	Tête Jaune mainstem	02-21-27	563	16	98.8%[c]	547
1980	Tête Jaune mainstem	02-18-61	259	0	100%	259
1980	Swift Creek	02-18-61	62	1	100%	61

a Release date is 24 to 48 hrs later.

b Measured May 8.

c The 7 chinook with rejected tags were retagged.

d Corrected for tag retention and post-tagging mortality.

No mortalities upon release were observed among fish transported in 1979 and 1980 from Moose Lake to release sites.

TAG RECAPTURE

During the August 26 to September 5, 1979 tag recapture program, 125 chinook juveniles were minnow trapped (Append.5). Of these fish, 63 were missing an adipose fin and were assumed to be part of that year's earlier tagging program on the mainstem; the remaining fish were unmarked. Over 95% of the recaptured marks were trapped in a 4 km reach between the 1979 release site at the head of Tête Jaune islands and the 1979 inclined plane trapping site (Fig 2, Append.5). No marked chinook were recaptured upstream of Rearguard Falls (Area A-C, Append.5) and only one marked chinook was recaptured below the Tête Jaune islands (Area F, Append.5).

In 1980, four chinook marked the previous year, were captured in inclined plane traps on the mainstem; all four fish had retained their nose tags. In 1981, 2,205 fry marked earlier in the same year were recaptured; 98.4%had retained their nose tags.

BIOLOGICAL SAMPLING

Biological sampling data are summarized in Figure 6, Table 7 and Appendices 6 to 8.

Newly emergent chinook fry captured in 1979 and 1980 in the mainstem and Swift Creek measured approximately 36 mm and 0.4 g. In 1979 and 1980, pen rearing chinook fry showed a similar overall size increase from May 8 to July 31, from 36 mm to around 58 mm and from 0.4 g to around 2.2 g. The above size means were derived from growth data means for individual rearing enclosures (Append. 6 and 7) which generally did not hold distinct fry populations due to fish redistributions among pens during rearing.

In 1981, the naturally rearing chinook fry captured in the mainstem during June 8 to 27, averaged 47 mm and 1.0 g and showed little increase in size with time. Chinook fry captured concurrently that year in the "Oxbow Lake" area showed a mean size increase from 45 mm to 55 mm and from 0.9 g to 2.3 g. All chinook juveniles sampled for scale smears in 1981 were age 0+.

Marked fry captured during the tag recapture program in 1979 averaged 63.0 ± 1.3 mm (95% C.L.) (range of 51 mm - 75 mm); unmarked fry averaged 64.9± 2.0 mm (95% C.L.) (range of 52 mm - 80 mm). Of the total fry captured at that time, 98.4% were age 0+ and only two unmarked chinook were age 1±.

The daily specific % growth rate during pen-rearing in 1979 and 1980 was calculated as follows:

$$\frac{(\ln b - \ln a)}{t_f - t_i} \times 100\% .$$

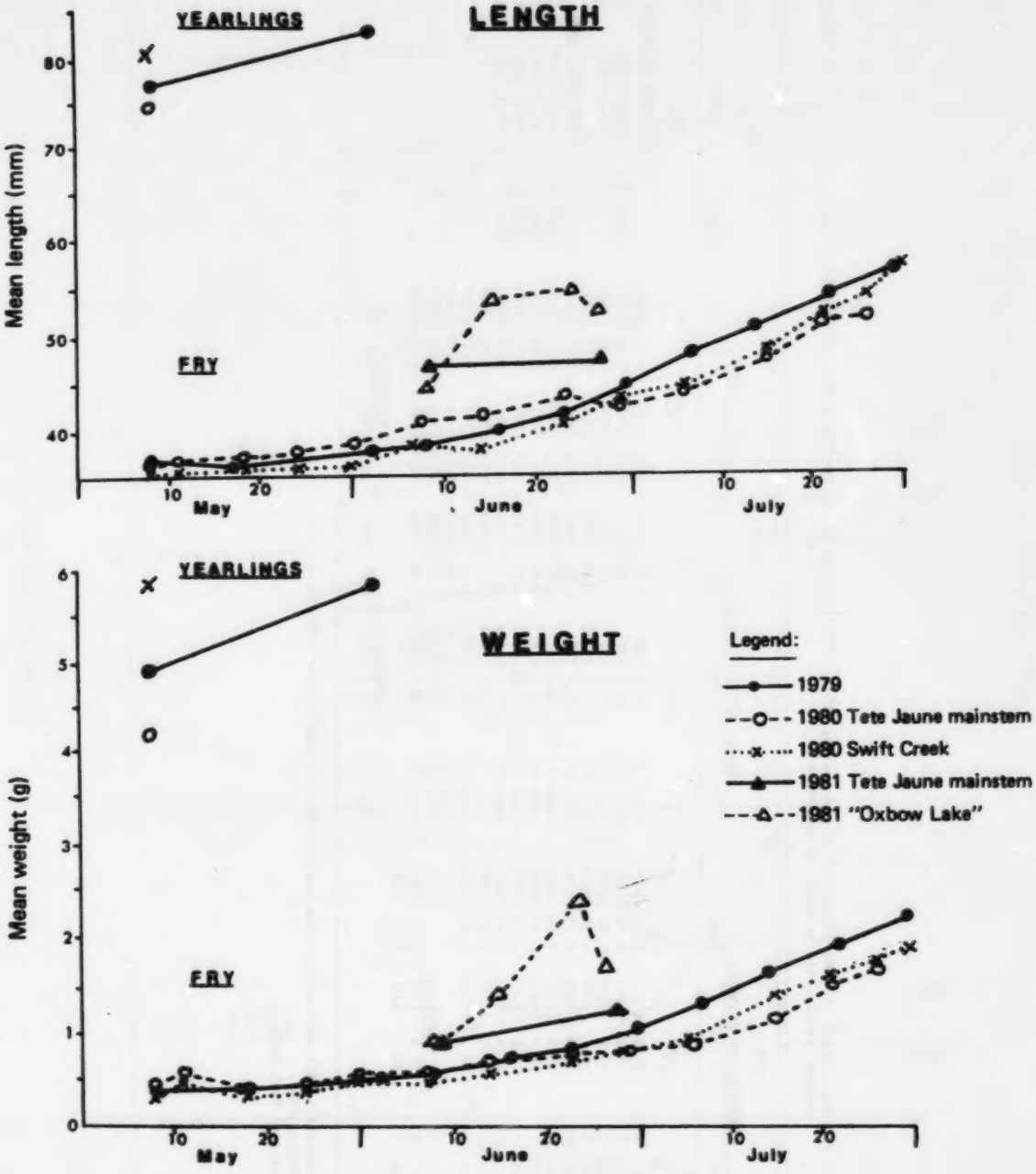

Fig. 6. Mean length and weight of pen-rearing (1979 and 1980) and naturally rearing (1981) chinook fry and yearlings captured at Tete Jaune and Swift Creek.

Table 7. Mean length (L) and weight (W)[a] of pen-rearing (1979, 1980) and naturally rearing (1981) chinook juveniles captured in upper Fraser River system (sample size is given in parenthesis).

1979			1980				1981		
FRASER RIVER MAINSTEM			FRASER RIVER MAINSTEM		SWIFT CREEK				
Date	L (mm)	W(g)	Date	L (mm)	W(g)	L (mm) W(g)	Date	L (mm)	W(g)
	FRY			FRY		FRY		FRY	
								TETE JAUNE MAINSTEM	
May 8	36.6 (25)	0.42 (50)	May 8	36.2 (50)	0.47 (100)	35.5 (50) 0.37 (100)	June 8	46.6 (30)	0.87 (100)
May 17	36.1 (75)	0.39 (150)	May 11	36.8 (30)	0.56 (50)	35.5 (30) 0.49 (50)	June 27	47.4 (30)	1.15 (100)
June 2	37.6 (100)	0.52 (250)	May 18	37.2 (50)	0.40 (200)	36.0 (50) 0.34 (300)			
June 8	38.2 (125)	0.56 (500)	May 24	37.8 (120)	0.48 (200)	35.7 (90) 0.39 (150)		OXBOW LAKE AREA	
June 16	39.8 (125)	0.73 (500)	May 31	38.7 (60)	0.55 (100)	36.2 (60) 0.50 (100)			
June 23	41.8 (125)	0.78 (500)	June 7 & 8	40.6 (175)	0.58 (400)	38.0 (105) 0.50 (200)	June 8	44.6 (100)	0.93 (100)
July 1	44.7 (125)	1.03 (500)	June 14	41.5 (140)	0.68 (382)	37.7 (70) 0.53 (200)	June 16	53.4 (60)	1.48 (200)
July 7	47.8 (125)	1.29 (500)	June 22&24	43.8 (139)	0.76 (500)	41.3 (70) 0.71 (200)	June 23	54.9 (30)	2.26 (100)
July 14	50.8 (100)	1.61 (600)	June 29	42.5 (140)	0.76 (500)	42.2 (70) 0.78 (200)	June 27	52.9 (30)	1.69 (100)
July 22	54.1 (175)	1.90 (700)	July 6	43.6 (140)	0.87 (500)	43.4 (70) 0.92 (200)			
July 27-31[b]	56.5 (250)	2.16 (500)	July 15	47.3 (140)	1.13 (500)	48.6 (70) 1.35 (200)			
			July 21	51.2 (140)	1.30 (500)[c]	51.9 (70) 1.63 (200)			
	YEARLINGS		July 28	51.6 (140)	1.65 (500)	54.1 (70) 1.76 (200)			
May 8	76.8 (25)	4.9 (50)	July 30	60.8 (70)[c]	2.44 (200)[c]	56.9 (70) 1.93 (200)			
June 2	82.5 (25)	5.8 (50)							
				YEARLINGS		YEARLINGS			
			May 8	74.6 (30)	4.2 (30)	80.2 (30) 5.8 (30)			

a Overall length and weight means are averages of sample means (Append. 6 - 8).
b Tagged fish.
c Raceway fish only.

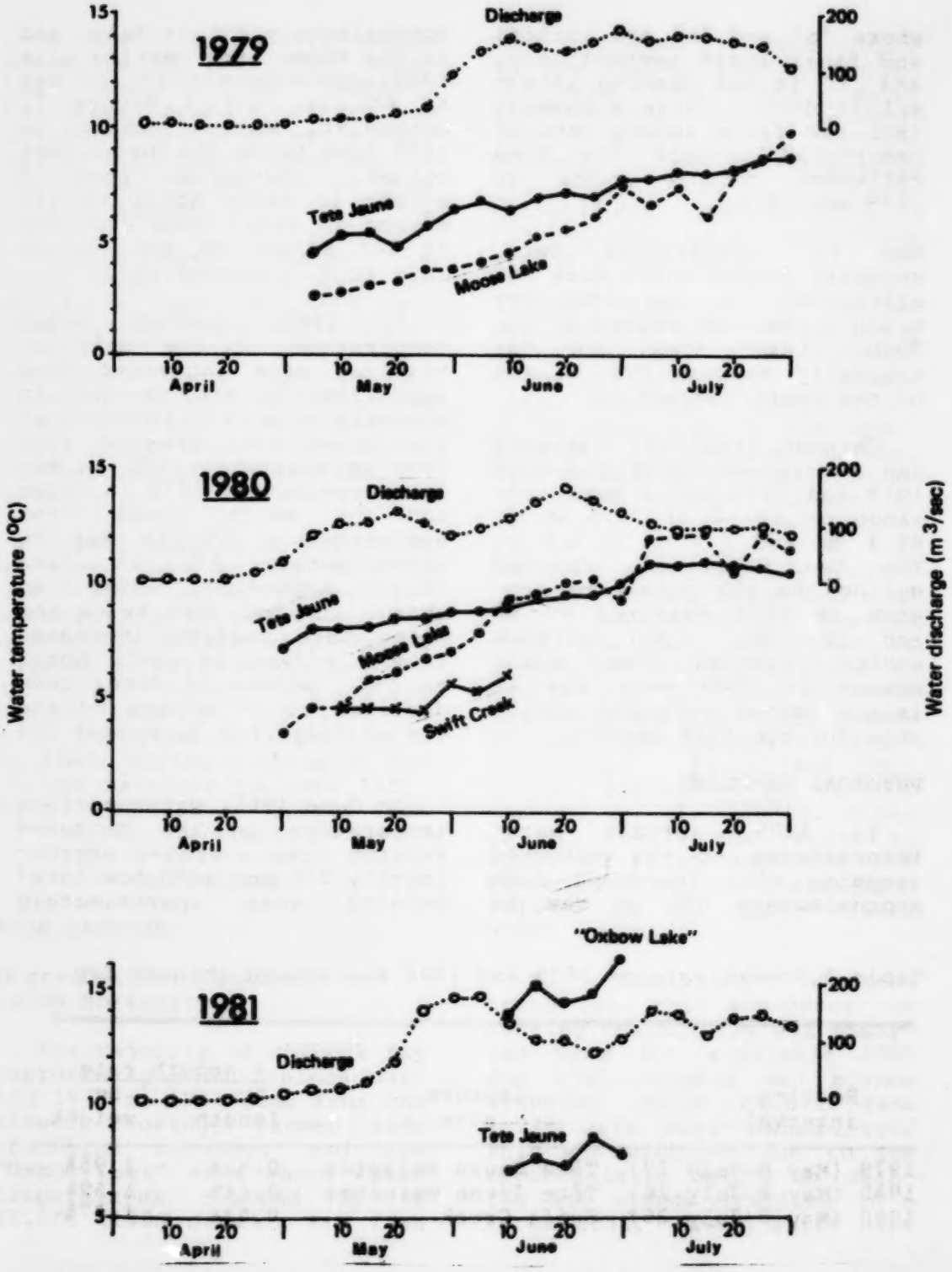

Fig. 7. Mean water temperatures (5-day means) in upper Fraser River at Tete Jaune, Swift Creek, Moose Lake outlet, and Oxbow Lake ; and mean water discharge (5-day means) at Moose Lake outlet, 1979-1981.

where 'a' and 'b' are initial and final sizes respectively, and 't' is the rearing interval in days. Table 8 summarizes the daily growth rate of pen-reared chinook fry from different capture sites in 1979 and 1980.

Due to insufficient data, separate growth rates were not calculated for the 1980 fry beach seined and reared in the "Oxbow Lake" area, nor for naturally rearing fry in any of the years sampled.

Chinook yearlings captured and pen-reared briefly during 1979 and 1980 had a mean size range on May 8 of 74.6 mm to 80.2 mm and 4.2 g to 5.8 g. The two yearlings captured during the tag recapture program in 1979 measured 89 mm and 101 mm. All chinook smolts sampled for scale smears in 1980 were age 1+ (scale smears were not available for the 1979 smolts).

PHYSICAL SAMPLING

In 1979, surface water temperatures at the mainstem trapping site increased from approximately 5°C in May to approximately 8°C in July, and at the Moose Lake rearing site from approximately 3°C in May to 8°C in July (Figure 7, Append.9). Water discharge in 1979 just below the Moose Lake outlet, increased from 5 m^3/sec in early April to 171 m^3/sec in June, then declined to 107 m^3/sec by the end of July (Fig.7, Append.10).

In 1980, surface water temperature at the mainstem trapping site increased from approximately 8°C in May to approximately 11°C in July; at the Moose Lake rearing site from approximately 6°C in May to approximately 12°C in July; and in Swift Creek from approximately 5°C in May to approximately 6°C in June (Fig.7, Append.9). Water discharge in 1980 just below the Moose Lake outlet, increased from 4 m^3/sec in early April to 168 m^3/sec in June, then declined to 88 m^3/sec by the end of July (Fig.7, Append 10)

In June 1981, water surface temperature in the mainstem seining area averaged approximately 8°C and in"Oxbow Lake" seining area approximately

Table 8.Growth rate of 1979 and 1980 Pen-reared chinook fry.

Rearing interval	Capture site	% growth rate by length	% growth rate by weight
1979 (May 8-July 29)	Tête Jaune mainstem	0.52%	1.95%
1980 (May 8-July 26)	Tête Jaune mainstem	0.44%	1.59%
1980 (May 8-July 26)	Swift Creek	0.53%	1.97%

15°C (Fig.7, Append.9). Water discharge in 1981 just below the Moose Lake outlet, increased from 6 m^3/sec in early May to 183 m^3/sec at the end of May, then declined to 130 m^3/sec by the end of July (Fig.7, Append.10).

During fish transport to Moose Lake rearing site in April to June of 1979 and 1980, water temperature averaged 4°C. During fish transport from Moose Lake to release site on the mainstem (July 1979 and 1980) and on Swift Creek (July 1980) water temperature ranged from 9°C to 11°C.

During tagging of yearlings at Moose Lake in May of 1979 and 1980, water temperature averaged 3.5°C and 6.5°C respectively (Table 6). During tagging of fry at Moose Lake in July, water temperature ranged from 8°C to 12°C in 1979 and from 10°C to 12.5°C in 1980; during tagging of fry in the mainstem in June 1981, water temperature ranged from 13°C to 16.5°C (Table 5).

DISCUSSION

FISH CAPTURE

Distribution, Abundance and Catch Mortality

The majority of chinook fry captured by beach seines during 1979 to 1981 came from the slower flowing, warmer side channels, marshes, and the "Oxbow Lake" area where water temperatures reached up to 22.5°C (1980 data). Few fish were captured by beach seines in the cooler side-waters of the main river channel where temperatures rarely exceeded 10°C. Stein et al. (1972), Shepherd (1979) and Rosberg et al. (1982) also observed chinook fry rearing in slow flowing and sheltered areas around stream margins.

The recovery of marked chinook fry during August to September of 1979 in the vicinity of their release site, suggests local rearing of at least some of the emergent fry. A portion of these fish remain to over-winter, as indicated by the capture of outmigrating yearlings in the spring of 1979 and 1980. In the present study, the proportion of chinook juveniles migrating as yearlings appeared very low and could not be quantified due to setting of traps after the onset of smolt migration and the inefficiency of gear in capturing larger juveniles. Tutty and Yole (1978), Olmsted et al. (1980), Rosberg et al. (1982), Scott et al. (1982) and Fraser et al.(1982) also reported the presence of overwintering chinook in the upper Fraser River system.

No consistent seasonal trend in the abundance of rearing chinook fry was observed from the available 1980 and 1981 seining and minnow trapping catch effort data (1979 data were incomplete). This was probably due to the opportunistic nature of seining and minnow trapping in a large area. The greater over

all mean catch per seine set during 1981 (130.8 fish) compared to 1980 (43.0 fish) may reflect differences in the knowledge of the study area in 1981 and the consequent selection that year of more productive seining sites rather than differences in population size.

Data from the 1979 tag recaptures could not be used to estimate fry population size since trapping was conducted with variable effort and different sites.

The higher mortality of fry caught by beach seine (up to 11% in 1980) compared to inclined plane traps (2% - 3%) is attributed to the greater handling of fish during seining and to the higher water temperatures in the seined areas. The relatively low fry mortality during seining in 1981 (0.8% of the annual catch) was due to less handling.

Migration Timing

Peak emergence and downstream distribution of chinook fry occurred from early to mid May and was generally similar to the timing for chinook fry in other upper Fraser River regions (Holmes River, Morkill River, Slim Creek and Torpy River)(Rosberg et al.1982). This timing is up to several weeks later than that observed for chinook in Thompson River tributaries, such as the Nicola River (DFO unpublished data), North Thompson River (Scott et al. 1982) and Lower Shuswap River (Fedorenko and Pearce 1982), where fry migrations generally peaked toward the end of April. Water temperature is one of the factors affecting juvenile migration and the above difference may be explained in part by different water temperatures observed in these areas.

Chinook yearlings from the mainstem and Swift Creek migrated largely in April and early May, or several weeks before peak fry migration. Similarily, peak migration of chinook yearlings from Holmes River, Morkill River and Slim Creek, is reported to occur during April, several weeks before peak fry migration (Rosberg et al.1982.). Chinook yearlings captured in the North Thompson River were also most abundant during April to May, becoming scarce by late May (Scott et al. 1982).

Factors affecting juvenile migration timing include: stream discharge, photoperiod, water temperature and fish growth (Bjornn 1971; Hoar 1976; Cramer and Lichatowich 1978; Rosberg et al. 1982). In the present study, the effect of flow on chinook catches was inconclusive. The flow peaked almost a month later in 1979 than in 1980 (Fig.7) yet the time of peak fry catches was generally similar in the two years(Fig. 5). By contrast, peak fry catches in Finn Creek, Raft River and North Thompson River (Scott et al. 1982); and from Quesnel River (Whelen et al.1981) were generally observed to coincide with initial increase in discharge.

The migration of chinook yearlings from the mainstem and Swift Creek apparently ended before the first increase in discharge. By contrast, migration of chinook yearlings from the North Thompson River occurred during the period of peak discharge (Scott et al.1982).

In the present study, the effect of temperature on chinook juvenile migration timing was also inconclusive. Catches of chinook yearlings from the mainstem decreased several weeks earlier in 1980 compared to 1979. This may be related to the warmer water temperatures (by about 2°C - 3°C) in 1980 (Figs.5 & 7). However, migration timing of juvenile chinook captured in 1980 appeared to be similar in the mainstem and Swift Creek despite the cooler water temperatures (by 3 - 4°C) in Swift Creek. By contrast, Rosberg et al.(1982) reported that in streams with similar photoperiod and discharge patterns, warmer water temperatures in the spring may be related to earlier smolt migration. This can not be assessed in the present study as discharge pattern in Swift Creek was not monitored.

The above migration timing estimates for the Tête Jaune study area are biased to some extent by the incomplete catch records resulting from setting traps after the onset of migration; the variable trapping effort; and the variable trapping efficiency related to gear used, debris load in the river, and selection of capture sites.

FISH SIZES

In 1979, over 90% of all chinook fry captured in late April and early May were newly emergent (indicated by presence of yolk sacs) as were approximately 50% of all fry captured in 1980 in the inclined plane traps. In 1981, the program started in June, and no fish captured still contained yolk sacs. Newly emergent fry in the mainstem and Swift Creek, (approximatly 36 mm and 0.4 g) were similar in size to chinook fry in other regions of the Fraser River (Tutty and Yole 1978; Olmsted et al.1980; Rosberg et al.1982; Scott et al.1982). No consistently significant ($p \leq 0.05$) differences in sizes were observed among fry from the 1979 mainstem catch, the 1980 mainstem catch and the 1980 Swift Creek catch (Append.6 & 7). Also, during each year, no consistently significant ($p \leq 0.05$) size differences were observed among the individual rearing enclosures sampled concurrently, except during June, 1980, when fry beach seined in the "Oxbow Lake" area were significantly ($p \leq 0.05$) larger than fry trapped or seined concurrently in the mainstem (Append.7). Likewise, fry beach seined in June 1981 in the "Oxbow Lake" area were larger and showed a seasonal increase in size compared to fry captured in the mainstem that year, and were significantly ($p \leq 0.05$) larger than

fry pen-reared at the Moose Lake rearing site during June 1979 and 1980. The above size differences are attributed largely to the higher water temperatures and better rearing conditions in the "Oxbow Lake" area. Temperatures in the main river channel and Moose Lake rearing site were 5°C to 10°C cooler than in the "Oxbow Lake" area.

The apparent growth rates for the 1979 and 1980 pen-rearing fry were considerably lower than pen-rearing growth rates observed in other regions of the Fraser River, probably largely due to the lower rearing temperatures at the Moose Lake rearing site (generally 10°C) (Table 9).

Growth rates in the present study were similar in 1979 and 1980 (see above), but fish were somewhat larger in 1979 than in 1980 (Fig.6), despite the warmer water temperatures observed in 1980 at the capture and rearing sites. Compared to 1979, water temperatures in 1980 were up to 3°C higher at the Tête Jaune trapping site and up to 5°C higher at the Moose Lake rearing site (Append.9). During May and June 1980, fry captured in Swift Creek were generally smaller than those captured in the mainstem (Fig.6) probably largely due to the lower (up to 4°C) spring temperatures observed in Swift Creek (Append.9).

In this study, the calculated growth rates for the 1979 and 1980 pen-rearing fry only approximate the actual growth rates since these fish came from a variety of capture sites, and newly trapped fry were added to the rearing enclosures until mid-June in both years.

The marked and unmarked chinook fry from the 1979 tag recovery program, showed no significant ($p \leq 0.05$) difference in length. This was due in part to the great size range observed among the captured fish (51 - 80 mm), but also suggests that the pen-reared marked fry had sizes representitive of the naturally rearing fry.

No significant ($p \leq 0.05$) size differences were observed among yearlings from the 1979 mainstem catch, the 1980 mainstem catch, and the 1980 Swift Creek catch (Append. 6& 7). Sizes of chinook yearlings during May 1979 and 1980 were comparable to sizes of chinook yearlings from other regions of the upper Fraser River (Rosberg et al. 1982) but were smaller than the Finn Creek and North Thompson River chinook yearlings (Scott et al. 1982) (Table 10).

While the average May water temperatures were generally similar in the above areas, it is likely that chinook overwintering in the upper most Fraser River watershed experienced longer and colder winters and consequently reduced spring growth compared to chinook from other Fraser River tributaries (comparable early spring water temperatures are not available).

Table 9. Comparison between growth rate of upper Fraser River chinook fry and fry from other Fraser River tributaries.

Rearing site	River System	% growth rate by length	% growth rate by weight	Reference
1979	Tête Jaune mainstem	0.52%	1.95%	Present study
1980	Tête Jaune mainstem	0.44%	1.59%	Present study
1980	Swift Creek	0.53%	1.97%	Present study
1980	Stuart River	0.83%	3.65%	Lister and Ass.Ltd.1981
1979	Nechako River and Quesnel River	0.72%-1.29%		Olmsted et al 1980
1979, 1980	Lower Shuswap River	0.90%-0.93%	3.35%-3.48%	Fedorenko and Pearce. 1983

Table 10.Comparison between size of upper Fraser River chinook yearlings and yearlings from other Fraser River tributaries.

Date	River system	Mean size l. (mm)	Mean size w. (g)	Avg. May water temp.	Reference
May 8,1979,1980	Tête Jaune mainstem	74.6-76.8	4.2-4.9	5-8	Present study
May 8,1980	Swift Cr.	80.2		5	Present study
April/May, 1981	Slim Cr., Morkill Cr., Holmes R., Torpy R.	80.9-84.0	6.0-6.8	5-6	Rosberg et al 1982.
April/May, 1981	Finn Cr. and North Thompson R.	84.2-89.9	7.0-7.6	5-7	Scott et al 1982

SUMMARY

1. During 1979, 1980, and 1981, juvenile chinook in the upper Fraser River mainstem at Tête Jaune were captured and coded wire nosed tagged. Chinook fry were pen-reared mostly at Moose Lake prior to tagging in 1979 and 1980, and were tagged when captured in 1981.

2. Between April and June of 1979 and 1980 and during June of 1981, an estimated 88,559, 55,467 and 29,470 chinook fry, as well as 666, 281 and 0 chinook yearlings were captured in each consecutive year in the mainstem using inclined plane traps and beach seines (but only beach seines and minnow traps in 1981).

3. Between April and June of 1980, an estimated 17,086 chinook fry and 63 chinook yearlings were captured in Swift Creek using inclined plane traps.

4. Mean daily catch per beach seine set averaged 43.0 chinook in 1980 and 130.8 chinook in 1981; mean daily catch per minnow trap averaged 8.3 chinook in 1981. No consistent seasonal trend in catch rate was evident.

5. Chinook fry emergence and downstream distribution in the mainstem and Swift Creek occurred from the end of April to mid-June, with the migration peak observed around mid-May. Major chinook yearlings migration from the mainstem and Swift Creek occurred in April (1980 data) and early May (1979 data). Size of emergent fry averaged 36 mm and 0.4 g in early May; size of migrating yearlings averaged 77 mm and 5.0 g at that time.

6. During 1979 and 1980, fry pen-reared in Moose Lake from May to July increased in size from approximately 36 mm to 58 mm and from 0.4 g to 2.2g. In 1981, fry rearing naturally during June, averaged 47 mm and 1.0 g for the mainstem fish, but increased from 45 mm to 55 mm and from 0.9 g to 2.3 g for fish rearing in warmer "Oxbow" area. During early May (May 8) chinook yearlings captured in the mainstem (1979, 1980) and Swift Creek (1980) ranged in mean size from 74.6 mm to 80.2 mm and from 4.2 g to 5.8 g.

7. During rearing of fry from April to July of 1979 and 1980, rearing mortality averaged 7.0% and 11.4% respectively, and overall % growth rate averaged 0.50% by length and 1.84% by weight. During rearing of chinook yearlings in May of 1979 and 1980, rearing mortality averaged 0.9% and 2.1% respectively.

8. In 1979, 77,688 chinook fry (mean length 57 mm, mean weight 2.2 g) and 547 chinook yearlings (mean length 83 mm, mean weight 5-8 g) from the Fraser River mainstem were tagged with codes 02-19-22 and 02-21-27 respectively.

In 1980, 30,680 chinook fry (mean length 53 mm, mean weight 2.8 g) captured by inclined plane trap, 10,107 chinook fry (mean length)

45-49 mm and mean weight 0.8-1.4 g) captured by beach seine, and 259 chinook yearlings (mean length 75 mm, mean weight 4.2 g) from the Fraser River mainstem were tagged with codes 02-18-13, 02-20-63 and 02-18-61 respectively. In addition 14,148 chinook fry (mean length 54 mm, mean weight 1.8 g) and 61 chinook yearlings (mean length 80 mm, mean weight 5.8 g) from Swift Creek were tagged with codes 02-18-11 and 02-18-61 respectively.

In 1981, 23,685 chinook fry (mean length 54 mm, mean weight 1.5 g) from the Fraser River mainstem were tagged with code 02-19-38.

9. Overall mean tag retention averaged 98% for fry and 99% for yearlings. Pre and post-tagging mortalities were each less than 1% of total taggable fry and less than 2% of total taggable yearlings. Water temperatures at tagging sites ranged from 3.5°C to 6.5°C during tagging of yearlings, and from 8.0°C to 16.5°C during tagging of fry.

10. During the tag recovery program in 1979, 63 chinook juveniles were captured with a missing adipose fin. No significant (p 0.05) size difference was observed between marked and unmarked fry captured and nearly all marked fish were recaptured in a 4 km mainstem reach below the 1979 fry release site.

11. In 1979 and 1980, water surface temperature at the Tête Jaune trapping site and Moose Lake rearing site increased from approximately 5°C - 8°C in May to 8°C - 12°C in July. In 1980, water temperature in Swift Creek increased from approximately 5°C in May to approximately 6°C in June. In 1981, water temperature in the mainstem averaged approximately 8°C and in the Oxbow Lake area approximately 15°C.

12. Water discharge at Moose Lake outlet during 1979, 1980, and 1981 generally increased from 4-6 m^3/sec in early April to 170-180 m^3/sec in June, then declined to 90-130 m^3/sec by the end of July. The discharge first peaked almost one month earlier in 1980 (early May) compared to 1979 and 1981.

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Appendix 1. Estimated daily numbers of 0+ and 1+ chinook juveniles captured by inclined plane traps (IPT) (sum of 4x4, 2x2 - #1 + 2x2- #2) and beach seines in Tête Jaune mainstem, April-June, 1979.

Date	0+ CHINOOK						1+ CHINOOK			
	IPT		Beach seines				IPT		Beach seines [a]	
	Total Catch	No. dead	Total Catch	No. dead	No. sets	No. fish /set	Total Catch	No. dead	Total Catch	No. dead
04/26[b]	413	2	-[c]				0	0		
04/27	1775	10	-				1	0		
04/28	2673	18	-				7	0		
04/29	3019	45	-				14	1		
04/30	4456	92	-				27	0		
05/01	4155	211	-				40	0		
05/02	2467	85	-				44	0		
05/03	1140	11	-				67	5		
05/04	1999	11	-				26	1		
05/05	1734	139	-				67	0		
05/06	2250	189	-				58	10		
05/07	1780	109	-				13	0		
05/08	1050	53	-				22	0		
05/09	908	62	-				20	0		
05/10	1174	14	-				3	0		
05/11	624	6	-				2	0		
05/12	1813	29	-				31	0		
05/13	1400	14	-				19	2		
05/14	2789	26	-				21	0		
05/15	3025	49	-				15	0		
05/16	6347	53	-				34	0		
05/17	4508	15	-				44	0		
05/18	2878	37	-				11	0		
05/19	1485	16	-				3	0		
05/20	2864	310	-				11	0		
05/21	2234	14	-				11	0		
05/22	2332	31	165	2	7	23.6	21	0	1	0
05/23	7517	29	-				9	0		
05/24	2512	52	569	0	6	94.8	4	0	0	0
05/25	1696	21	-				5	0		

Appendix 1 (cont'd).

Date	0+ CHINOOK						1+ CHINOOK			
	IPT		Beach seines				IPT		Beach seines [a]	
	Total Catch	No. dead	Total Catch	No. dead	No. sets	No. fish /set	Total Catch	No. dead	Total Catch	No. dead
05/26[d]	490	4	-				1	0		
05/27[e]	-	-	169	0	6	28.2	-	-	0	0
05/28[d]	57	0	-				0	0		
05/29[e]	-	-	610	2	15	40.7	-	-	0	0
05/30[d]	104	2	3366	66	20	168.3	0	0	0	0
05/31[f]	409	11	1561	38	N.A.[h]	N.A.	0	0	0	0
06/01[f]	373	4	505	0	9	56.1	0	0	0	0
06/02[f]	316	6	1652	7	N.A.	N.A.	0	0	0	0
06/03[f]	107	1	446	14	4	111.5	0	0	0	0
06/04[g]	-	-					-	-		
06/05	-	-					-	-		
06/06	-	-					-	-		
06/07	-	-					-	-		
06/08	-	-					-	-		
06/09	-	-					-	-		
06/10	-	-	528	86	17	3.1	-	-	0	0
06/11	-	-	31	0	N.A.	N.A.	-	-	1	0
06/12	-	-	144	53	N.A.	N.A.	-	-	0	0
06/13	-	-	12	1	N.A.	N.A.	-	-	0	0
06/14	-	-	221	12	N.A.	N.A.	-	-	0	0
06/15	-	-	1707	982	N.A.	N.A.	-	-	13	0
Total	76,873	1,781	11,686	1,263	-	-	651	19	15	0
(%)	(100)	(2.3)	(100)	(10.8)			(100)	(2.9)	(100)	(0)

a No. sets as for 0+ chinook.

b Traps 4x4 and 2x2 (#2) not fishing.

c Not fished.

d Traps 2x3 (#1 & 2) not fishing.

e No traps fishing.

f Trap 2x3 (#1) not fishing.

g Downstream trapping terminated after June 3.

h Not available.

Appendix 2. Estimated daily numbers of 0+ and 1+ chinook juveniles captured by incline plane traps (IPT) (sum of 4x4 #1 & 2 and 2x2 #1 & 2) and beach seines in Tête Jaune mainstem, April - June, 1980.

Date	0+ CHINOOK						1+ CHINOOK			
	IPT		Beach seines				IPT		Beach seines[a]	
	Total Catch	No. dead	Total Catch	No. dead	No. sets	No. fish/ set	Total Catch	No. dead	Total Catch	No. dead
04/24[b]	685	40	_[c]	_	_	_	63	0	_	_
04/25[b]	403	12	_	_	_	_	22	0	_	_
04/26	646	47	_	_	_	_	29	0	_	_
04/27	712	12	_	_	_	_	58	4	_	_
04/28	494	11	_	_	_	_	13	1	_	_
04/29	373	17	_	_	_	_	22	0	_	_
04/30	244	6	275	0	7	39.3	17	0	0	0
05/01[d]	313	7	1	0	2	0.5	12	0	0	0
05/02[d]	333	8	161	0	5	32.2	4	0	0	0
05/03[d]	320	18	11	0	6	1.8	4	0	0	0
05/04[d]	661	60	_	_	_	_	18	0	_	_
05/05[d]	774	28	_	_	_	_	4	0	_	_
05/06[d]	730	7	_	_	_	_	2	0	_	_
05/07[d]	722	7	_	_	_	_	3	0	_	_
05/08[d]	590	2	_	_	_	_	3	0	_	_
05/09	771	6	_	_	_	_	2	0	_	_
05/10[d]	1274	138	_	_	_	_	1	0	_	_
05/11[d]	1140	10	_	_	_	_	1	0	_	_
05/12[d]	1768	24	_	_	_	_	1	0	_	_
05/13[d]	1117	22	_	_	_	_	1	1	_	_
05/14[d]	761	5	_	_	_	_	0	0	_	_
05/15[d]	2716	18	_	_	_	_	0	0	_	_
05/16[d]	1749	17	_	_	_	_	0	0	_	_
05/17[d]	1377	5	_	_	_	_	0	0	_	_
05/18[d]	410	2	_	_	_	_	0	0	_	_
05/19[d]	985	5	_	_	_	_	0	0	_	_
05/20[d]	1260	2	_	_	_	_	0	0	_	_
05/21[d]	1001	3	_	_	_	_	0	0	_	_
05/22[d]	362	6	_	_	_	_	0	0	_	_
05/23	680	9	_	_	_	_	1	0	_	_

Appendix 2 (cont'd).

Date	0+ CHINOOK						1+ CHINOOK			
	IPT		Beach seines				IPT		Beach seines[a]	
	Total Catch	No. dead	Total Catch	No. dead	No. sets	No. fish/set	Total Catch	No. dead	Total Catch	No. dead
05/24[e]	475	18	217	1	3	72.3	0	0	0	0
05/25	824	13	615	0	14	43.9	0	0	0	0
05/26	1848	9	1021	0	24	42.5	0	0	0	0
05/27	682	3	262	0	14	18.7	0	0	0	0
05/28	710	5	461	0	4	115.3	0	0	0	0
05/29	668	1	280	0	10	28.0	0	0	0	0
05/30	512	5	174	0	10	17.4	0	0	0	0
05/31	601	16	–	–	–	–	0	0	–	–
06/01	1106	13	845	0	19	44.5	0	0	0	0
06/02	370	48	653	161	20	32.7	0	0	0	0
06/03	1189	16	613	7	13	47.2	0	0	0	0
06/04	260	11	581	5	19	30.6	0	0	0	0
06/05	225	1	700	400	18	38.9	0	0	0	0
06/06	207	3	1160	0	13	89.2	0	0	0	0
06/07	181	7	1995	0	23	86.7	0	0	0	0
06/08	305	3	1241	28	10	124.1	0	0	0	0
06/09	85	1	1512	0	25	60.5	0	0	0	0
06/10	27	1	1494	0	24	62.3	0	0	0	0
06/11	29	0	1730	0	43	40.2	0	0	0	0
06/12	10	0	548	0	8	68.5	0	0	0	0
06/13	12	0	346	0	11	31.5	0	0	0	0
06/14	11	0	669	0	15	44.6	0	0	0	0
06/15			373	24	14	15.5	0	0	0	0
06/16	–	–	556	27	29	19.2	–	–	0	0
06/17	–	–	622	0	18	34.6	–	–	0	0
06/18	–	–	643	1	38	16.9	–	–	0	0
						$\bar{x}$ = 43.0				
Total	35,708	728	19,759	654	459	–	281	6	0	0
(%)	(100)	(2.0)	(100)	(3.3)			(100)	2-1)		

a No. sets as for 0+ chinook.

b 2x3 traps not fishing.

c Not fished.

d One 2x3 trap not fishing.

e After this date, 2x3 traps not fishing.

Appendix 3. Estimated daily numbers of 0+ chinook juveniles captured by beach seines and minnow traps in Tête Jaune mainstem, June, 1981.

Date	Beach seines				Minnow traps			
	Total Catch	No. dead	No. sets	No. fish/ set	Total Catch	No. dead	No. traps	No. fish/ traps
06/08	429	0	5	85.8	-[a]	-	-	-
06/09	-	-	-	-	-	-	-	-
06/10	1667	65	14	119.1	361	0	34	10.6
06/11	2170	8	18	120.6	1501	2	103	14.6
06/12	931	3	15	62.1	1169	0	120	9.7
06/13	1090	3	5	218.0	1054	17	120	8.8
06/14	767	3	7	109.6	849	0	108	7.9
06/15	1410	31	7	201.4	863	2	113	7.6
06/16	1363	3	4	340.8	844	4	85	9.9
06/17	1339	10	8	167.4	804	2	79	10.2
06/18	1135	3	5	227.0	744	2	97	7.7
06/19	1155	7	6	192.5	719	0	95	7.6
06/20	1349	7	10	134.9	402	5	64	6.3
06/21	653	18	7	93.3	490	0	47	10.4
06/22	2431	0	40	60.8	337	1	47	7.2
06/23	-	-	-	-	242	6	49	4.9
06/24	-	-	-	-	-	-	-	-
06/25	47	0	5	9.4	-	-	-	-
06/26	776	0	25	31.0	-	-	-	-
06/27	300	0	6	50.0	79	0	48	1.6
				$\bar{x}$ =130.8				$\bar{x}$ = 8.3
Total	19,012	1 1	187	-	10,458	41	-	-
(%)	(100)	(0.8)			(100)	(0.4)		

[a] Not fished.

Appendix 4. Estimated daily numbers of 0+ and 1+ chinook juveniles captured by inclined plane traps (IPT) (2x3, #1, #2 & #3) and minnow traps in Swift Creek, April - June, 1980.

Date	0+ CHINOOK					1+ CHINOOK	
	IPT		Minnow traps			IPT	
	Total Catch	No. dead	Total Catch	No. dead	No. traps	Total Catch	No. dead
04/25[a]	518	27	-	[b]	-	31	0
04/26[a]	420	25	-		-	5	1
04/27[a]	428	5	-		-	5	0
04/28[a]	66	6	-		-	2	0
04/29[a]	212	1	-		-	6	0
04/30[a]	212	5	-		-	4	0
05/01[a]	260	1	-		-	3	0
05/02[a]	105	0	-		-	0	0
05/03[a]	262	1	-		-	0	0
05/04	296	2	-		-	0	0
05/05[a]	962	109	-		-	1	0
05/06[a]	577	9	-		-	1	0
05/07[a]	568	9	-		-	2	0
05/08[a]	454	3	-		-	2	0
05/09[a]	1053	11	-		-	0	0
05/10[a]	843	49	-		-	1	0
05/11	598	15	-		-	0	0
05/12	646	17	-		-	0	0
05/13	674	8	-		-	0	0
05/14	588	4	-		-	0	0
05/15	622	16	-		-	0	0
05/16	211	9	-		-	0	0
05/17	427	21	-		-	0	0
05/18	277	9	-		-	0	0
05/19	162	8	-		-	0	0
05/20[c]	423	12	-		-	0	0
05/21	280	3	-		-	0	0
05/22	213	8	-		-	0	0
05/23	245	11	-		-	0	0
05/24	279	18	-		-	0	0
05/25	431	4	-		-	0	0

Appendix 4 (cont'd).

Date	0+ CHINOOK					1+ CHINOOK	
	IPT		Minnow traps			IPT	
	Total Catch	No. dead	Total Catch	No. dead	No. traps	Total Catch	No. dead
05/26	552	10	-		-	0	0
05/27	270	13	-		-	0	0
05/28	357	21	-		-	0	0
05/29	372	19	-		-	0	0
05/30	348	10	-		-	0	0
05/31	333	6	-		-	0	0
06/01	294	8	-		-	0	0
06/02	208	2	-		-	0	0
06/03	277	4	-		-	0	0
06/04	108	7	-		-	0	0
06/05	116	11	-		-	0	0
06/06	102	13	-		-	0	0
06/07	105	17	-		-	0	0
06/08	164	14	-		-	0	0
06/09	81	12	-		-	0	0
06/10	51	19	-		-	0	0
06/11	14	1	4	0	6	0	0
06/12	-	-	18	0	6	0	0
06/13	-	-	0	0	6	0	0
Total	17,064	613	22	0	-	63	1
(% dead)	(100)	(3.6)	(100)	(0)	-	(100)	(1.6)

a Only trap #1 fishing.

b Not fished.

c Only traps #2 and #3 fishing.

Appendix 5. Minnow trapping summary for tag recapture program in Upper Fraser River, August - September, 1979.

Date	Trapping area[a]	Trapping site	Effort		No. Chinook Captured	
			No. traps	No. hours/trap	Marked	Unmarked
Aug. 26	A	1	5	0.75	0	0
	A	2	5	0.75	0	0
	A	3	5	0.75	0	5
	A	4	5	0.75	0	2
Aug. 29	B	5	5	2.5	0	4
	C	6	5	2.1	0	2
	C	7	5	2.1	0	2
Aug. 30	D	8	5	17.5	0	3
	E	9	5	18	9	4
	E	10	5	18	7	5
	E	11	5	18	19	0
	E	12	5	18	2	1
	E	13	5	1.75	1	1
	E	14	5	1.5	1	1
	E	15	5	1.5	1	5
	E	16	5	1.5	3	5
	E	17	5	1.5	0	0
Aug. 31	E	18	5	16.5	2	1
	E	19	3	16.5	1	6
	E	20	5	16.5	4	2
	E	21	5	16.5	4	3
	E	22	5	16.5	1	3
Sept. 1	F	23	5	27	0	1
	F	24	5	27	0	0
	F	25	5	27	1	3
	F	26	5	27	0	1
	F	27	4	27	0	0
Sept. 4	G	28	6	24	0	0
	G	29	5	24	0	1
	G	30	5	24	0	0
	G	31	5	24	0	0
Sept. 5	C	9	5	24	5	1
	C	33	5	24	2	0
Total	-	33	-	-	63	62

[a]Area A - Fraser River mainstem between Robson R. and Swiftcurrent Cr.,

Area B - Just downstream of Swiftcurrent Cr., outlet,

Area C - Just upstream of Tête Jaune "Island",

Area D - first trapping site downstream of Rearguard Falls,

Area E - Tête Jaune "Island",

Area F - from bottom of Tête Jaune "Island" to "Oxbow Lake" area,

Area G - below "Oxbow Lake" area; see Fig. 2 for area locations.

Appendix 6. Mean length (L± 95% C.L.) and weight (W) of chinook fry and yearlings from upper Fraser River by capture method and rearing enclosure, 1979
(n gives sample size).

Date	Capture Method[a]	Pen No.	n	L(mm)	n	W(g)	Date	Capture Method	Pen No.	n	L(mm)	n	W(g)
			FRY										
May 08	IPT	1	25	36.6±0.7	50	0.42	July 07	IPT	1	25	49.7±0.9	100	1.48
May 17	IPT	1	25	36.5±0.7	50	0.40	July 07	IPT	3	25	47.8±0.8	100	1.31
May 17	IPT	3	25	36.4±0.6	50	0.39	July 07	IPT	5	25	48.8±0.7	100	1.38
May 17	IPT	5	25	35.6±0.5	50	0.37	July 07	IPT	7	25	47.5±0.9	100	1.37
							July 07	IPT	9	25	45.1±1.1	100	1.07
June 02	IPT	1	20	39.1±0.6	50	0.58	July 14	IPT	1	25	55.2±1.1	100	1.95
June 02	IPT	3	20	38.1±0.5	50	0.54	July 14	IPT	3	25	49.3±1.4	100	1.42
June 02	IPT	5	20	37.2±0.5	50	0.53	July 14	IPT	5	25	50.8±0.9	100	1.68
June 02	IPT/BS	9	20	36.8±0.7	50	0.44	July 14	IPT/BS	R[6]	25	47.8±1.4	100	1.35
June 08	IPT	1	25	40.0±0.6	100	0.65	July 14	IPT	2	—	———	100	1.67
June 08	IPT	3	25	39.1±0.7	100	0.64	July 14	IPT	4	—	———	100	1.59
June 08	IPT	5	25	37.4±0.7	100	0.51							
June 08	IPT	7	25	37.3±0.6	100	0.51	July 22	IPT	1	25	57.1±1.6	100	2.20
June 08	IPT/BS	9	25	37.1±0.8	100	0.51	July 22	IPT	2	25	56.1±1.4	100	2.05
June 16	IPT	1	25	41.5±0.5	100	0.97	July 22	IPT	3	25	52.7±1.0	100	1.84
June 16	IPT	3	25	40.8±0.7	100	0.72	July 22	IPT	4	25	53.9±1.6	100	1.89
June 16	IPT	5	25	38.7±0.8	100	0.86	July 22	IPT	5	25	54.5±2.1	100	2.02
June 16	IPT	7	25	39.1±0.8	100	0.61	July 22	IPT/BS	R	25	50.9±1.1	100	1.63
June 16	IPT/BS	9	25	38.7±0.8	100	0.50	July 22	IPT/BS	R	25	53.5±1.7	100	1.64
June 23	IPT	1	25	42.4±1.6	100	0.91	July 27	IPT/BS	R	50[b]	53.7±1.1	100[b]	1.75
June 23	IPT	3	25	43.0±1.1	100	0.78							
June 23	IPT	5	25	41.8±1.0	100	0.82	July 28	IPT/BS	1R	50[b]	53.9±1.8	100[b]	1.79
June 23	IPT	7	25	41.0±0.8	100	0.68							
June 23	IPT/BS	9	25	41.0±1.1	100	0.69	July 29	IPT	1,2,4	50[b]	58.5±1.4	100[b]	2.62
July 01	IPT	1	25	47.2±1.0	100	1.33	July 30	IPT	3,5	50[b]	58.8±1.0	100[b]	2.56
July 01	IPT	3	25	44.8±0.7	100	0.94							
July 01	IPT	5	25	45.8±1.0	100	1.08	July 31	IPT	3,5	50[b]	57.8±1.0	100[b]	2.10
July 01	IPT	7	25	43.4±1.2	100	0.95							
July 01	IPT/BS	9	25	42.7±0.8	100	0.86			YEARLINGS				
[a]IPT - inclined plane trap							May 8	IPT	-	25	76.8±2.8	50	4.9
BS - beach seine							June 2	IPT	-	25	82.5±2.0	50	5.8
[b]Raceway													

Appendix 7. Mean length ($L \pm$ 95%C.L) and weight (W) of chinook fry and yearlings from upper Fraser River and Swift Creek, by capture method and rearing enclosure, 1980 (n gives sample size).

Date	FRASER RIVER MAINSTEM							SWIFT CREEK[b]				
	Capture method[a]	Pen No.	n	L(mm)	n	W(g)		Pen No.	n	L(mm)	n	W(g)
		FRY										
May 8	T.J.- IPT	1	50	36.2±0.5	100	0.47		1	50	35.5±0.4	100	0.37
May 11	T.J.- IPT	W[c]	30	36.8±0.6	50	0.56		W[c]	30	35.5±0.5	50	0.49
May 18	T.J.- IPT	1	25	37.1±0.6	100	0.40		1	25	35.8±0.7	100	0.34
"	T.J.- IPT	2	25	37.3±0.5	100	0.39		2	25	36.1±0.6	100	0.34
May 24	T.J.- IPT	1	30	37.3±0.9	50	0.46		1	30	36.1±0.6	50	0.44
"	T.J.- IPT	2	30	36.0±0.6	50	0.43		2	30	35.6±0.4	50	0.37
"	T.J.- IPT	W	30	36.7±0.6	50	0.39		W	30	35.3±0.7	50	0.35
"	T.J.- BS	W	30	41.0±2.5	50	0.64						
May 31	T.J.- BS	4[d]	30	38.6±1.5	50	0.52		1	30	35.8±0.7	50	0.48
"	T.J.- IPT	R[d]	30	38.7±0.6	50	0.58		2	30	36.6±0.4	50	0.51
June 7	T.J. IPT/BS	R	70	38.5±0.5	300	0.53		1	35	38.2±0.7	100	0.54
"	T.J. BS	4	35	41.3±1.6	100	0.63		2	35	36.9±0.6	100	0.46
June 8	T.J. IPT	W	35	37.4±1.1				W	35	39.0±0.9	-	
"	Oxbow-BS	W	35	45.0±1.6	=							
June 14	T.J.- BS	4	35	39.4±1.4	100	0.65		1	35	37.5±1.3	100	0.57
"	T.J. IPT/BS	R	35	39.5±2.2	100	0.63		2	35	37.8±0.7	100	0.49
"	Oxbow-BS	5	35	40.7±1.4	100	0.65						
"	Oxbow-BS	6	35	46.4±1.8	82	0.80						
June 22	Oxbow-BS	5&6	34	45.3±1.4	100	0.80						
June 24	T.J.- BS	4	35	41.5±1.4	100	0.68		1	35	42.1±0.9	100	0.75
"	T.J. IPT/BS	R	70	44.7±0.9	300	0.80		2	35	40.5±0.7	100	0.67
June 29	T.J. IPT/BS	3	35	42.4±1.7	100	0.73		1	35	42.7±0.9	100	0.82
"	T.J.- BS	4	35	42.5±1.5	100	0.78		2	35	41.6±1.0	100	0.74
"	T.J. IPT/BS	R	70	42.5±0.9	300	0.78						
July 6	T.J.- BS	4	35	42.8±1.2	100	0.87		1	35	43.7±1.4	100	1.00
"	T.J. IPT/BS	3	35	42.5±1.1	100	0.79		2	35	43.1±1.2	100	0.84
"	T.J. IPT/BS	R	70	45.4±1.3	300	0.95						
July 15	T.J.- BS	4	35	46.2±1.4	100	1.01		1	35	49.8±1.1	100	1.42
"	T.J. IPT/BS	3	35	47.5±1.9	100	1.07		2	35	47.3±1.1	100	1.28
"	T.J. IPT/BS	R	70	48.2±1.1	300	1.30						
July 21	T.J.- BS	4	35	51.1±1.8	100	1.32		1	35	53.4±1.6	100	1.76
"	T.J. IPT/BS	3	35	50.7±2.3	100	1.47		2	35	50.3±1.3	100	1.50
"	T.J. IPT/BS	R	70	51.7±1.8	300	1.72						
July 26	T.J.-BS	4	35	48.6±1.6	100	1.43		1	35	54.6±1.7	100	1.89
"	T.J. IPT/BS	3	35	53.7±2.5	100	1.54		2	35	53.5±1.4	100	1.62
"	T.J. IPT/BS	R	70	52.6±2.4	300	1.99						
July 30	T.J. IPT/BS	R	35	60.4±1.9	100	2.44		1	35	57.4±1.4	100	1.90
"	T.J. IPT/BS	R	35	61.1±1.9	100	2.44		2	35	56.3±1.2	100	1.93
		YEARLINGS								YEARLINGS		
May 8	T.J.- IPT	-	30	74.6±2.2	30	4.2		-	30	80.2±3.5	30	5.8

a T.J. IPT - Tête Jaune area, inclined plane traps;
T.J. BS - Tête Jaune area, beach seines;
Oxbow BS - Oxbow lake area, beach seines.

b All fish captured by inclined plane traps.

c That day's wild catch.

d Raceway.

Appendix 8. Mean length ($L \pm$ 95% C.L.) and weight (W) of chinook fry from upper Fraser River by capture method, 1981 (n gives sample size).

Capture date	Capture method[a]	n	L(mm)	n	W(g)
June 8	BS	100	44.6 ± 1.4	100	0.93
" 8[b]	BS	30	46.4 ± 1.8	100	0.87
" 14[c]	BS/MT	30	56.1 ± 2.5	100	1.47
" 15[c]	BS/MT	30	51.7 ± 1.9	100	1.17
" 16	MT	30	55.4 ± 2.2	100	1.61
" 16	BS	30	51.4 ± 1.9	100	1.31
" 17[c]	BS/MT	30	53.0 ± 2.2	100	1.39
" 18[c]	BS/MT	30	55.1 ± 2.1	100	1.53
" 19[c]	BS/MT	30	51.9 ± 2.2	100	1.35
" 20[c]	BS/MT	30	52.7 ± 2.8	100	1.51
" 21[c]	BS/MT	30	54.4 ± 2.3	100	1.53
" 23	MT	30	54.9 ± 2.2	100	2.26
" 23[c]	MT	30	52.1 ± 2.3	-	-
" 27	BS/MT	30	52.9 ± 2.5	100	1.69
" 27[b]	BS/MT	30	47.4 ± 1.9	100	1.15

[a] BS - beach seines; MT - minnow traps.

[b] Fish captured in Tete Jaune mainstem; others in Oxbow Lake area.

[c] Fry held for 24 - 48 hour after tagging, then measured and tested for tag retention; excludes undersized fry (<45mm).

Appendix 9. Five-day mean surface water temperatures (°C) at trapping and rearing sites in upper Fraser River system, 1979 - 1981.

Date	1979		1980			1981	
	Tête Jaune mainstem (trapping site)	Moose Lake (rearing site)	Tête Jaune mainstem (trapping site)	Swift Creek (trapping site)	Moose Lake (rearing site)	Tête Jaune mainstem (seining site)	Oxbow lake area (seining site)
Apr. 30	-[a]	-	7.1	-	3.5	-	-
May 4	4.4	2.5	8.0	-	4.6	-	-
May 10	5.1	2.7	8.0	4.5	4.7	-	-
May 15	5.2	3.0	8.1	4.5	5.9	-	-
May 20	4.8	3.2	8.5	4.5	6.1	-	-
May 25	5.6	3.7	8.5	4.5	6.7	-	-
May 31	6.5	3.6	8.8	5.6	7.0	-	-
June 5	6.9	4.1	8.8	5.4	7.9	-	-
June 10	6.6	4.5	9.0	6.0	9.3	7.1[b]	13.8[b]
June 15	7.0	5.2	9.4	-	9.5	7.6	15.0
June 20	7.2	5.5	9.5	-	10.0	7.2	14.2
June 25	7.0	6.1	9.5	-	10.2	8.5	14.8
June 30	7.7	7.5	10.0	-	9.4	7.8[b]	16.2[b]
July 5	7.9	6.6	11.0	-	12.0	-	-
July 10	8.1	7.4	10.9	-	12.1	-	-
July 15	8.0	6.0	11.1	-	12.2	-	-
July 20	8.2	8.3	10.8	-	10.5	-	-
July 25	8.8	8.8	10.7	-	12.2	-	-
July 31	8.9	9.9	10.5	-	11.5	-	-
Range of daily temperatures	2.5-9.0	2.5-11.8	6.5-11.2	4.0-7.0	3.5-13.0	6.5-9.0	12.2-16.5

a Not recorded.

b Two -to three-day's data.

Appendix 10. Five-day mean water discharge (m^3/sec) below Moose Lake outlet (Fraser River at Red Pass, Station No. 08KA007), 1979 - 1981.

Date	1979	1980	1981
April 5	5.1	4.1	6.1
10	5.3	4.2	5.9
15	5.2	4.3	5.9
20	5.2	6.2	6.1
25	5.2	11.6	9.1
30	6.6	38.0	14.5
May 5	12.0	81.4	23.5
10	16.3	100.7	25.8
15	18.2	105.2	34.8
20	24.0	127.8	70.3
25	33.4	100.8	160.2
31	92.9	79.7	182.7
June 5	132.3	93.6	181.8
10	158.6	110.8	134.4
15	143.4	142.0	104.4
20	138.2	168.0	105.2
25	152.8	148.4	86.8
30	171.0	127.6	107.4
July 5	153.8	102.8	157.4
10	161.6	87.7	149.4
15	160.4	95.6	113.2
20	150.6	96.1	141.4
25	145.6	99.1	147.2
31	106.8	88.2	130.0
Range of daily recorded discharges	4.9-199.0	4.1-178.0	5.9-206.0

POOR

QUALITY

ORIGINAL